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# INFORMATION PROCESSING AND THE INSTABILITY OF POLITICAL OUTCOMES

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A dissertation submitted to the faculty of the University of North Carolina at Chapel Hill in partial fulfillment of requirement for the degree of Doctor of Philosophy in the Department of Political Science.

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## ABSTRACT

**Derek A. Epp: Information Processing and the Instability of Political Outcomes.
(Under the direction of Frank R. Baumgartner)**

Studies in public policy document what is described as a 'punctuation equilibrium' pattern of change, where negative feedback forces that act to maintain the status-quo are occasionally disrupted, leading to brief and dramatic changes before a new equilibrium is rapidly established. The causal process that explains this pattern rests on fundamental limitations to human cognition and institutional capacity and as such, is thought to be widely applicable across organizational structures. From this perspective, punctuations are inevitable to the policymaking process, rather than rare, idiosyncratic events. In this dissertation, I search for the limits of the punctuated equilibrium framework by identifying conditions under which proportional, as opposed to punctuated, change is possible. I identify variance across organizations in their ability to process and respond to new information and by leveraging this variance, interrogate the causal mechanism behind punctuated equilibrium; using data from U.S. government budgets with corporate and financial data points as reference. I identify two factors as having a powerful effect on the stability of outputs– the scope of organizational focus and the degree to which organizations take a decentralized, or market-based, approach to decision-making. When organizations are sufficiently limited in scope or decentralize decision-making, output distributions show fewer extreme changes. The dissertation argues that these conditions are not especially uncommon. The implication is that highly punctuated change distributions, while certainly abundant in the public sector, are not inevitable to human decision-making processes.

## ACKNOWLEDGEMENTS

I would like to thank Frank Baumgartner. The best decision I made in graduate school was asking Frank to be my advisor. I was tipped off that he would be a good choice by a wall in his office that is covered with teaching accolades. He lived up to his reputation. Frank has obviously established himself as a terrific political scientist, what makes him a good mentor is that he is a terrific person – thoughtful, generous, and unfailingly supportive.

I would like to thank Jim Stimson, Virginia Gray, Tom Carsey, Chris Clark, and Mike MacKuen. Together with Frank, you taught me everything I know about political science; most important, that it is best as a collective enterprise, working together to think through problems. I would like to thank Greg Wolf, Amanda Grigg, John Lovett, and the rest of my graduate student colleagues. I am proud of what we accomplished together during our time at Chapel Hill. I would like to thank Brian Godfrey, my excellent and very capable research assistant. I would like to thank Erica, my always supportive and (usually) patient girlfriend. Most of all, I would like to thank my wonderful parents.

**TABLE OF CONTENTS**

## LIST OF TABLES

## LIST OF FIGURES

## CHAPTER ONE: INTRODUCTION

President Eisenhower was dismissive. Having been briefed on the R-7 Semyorka, the Soviet Union's powerful new rocket, he was well aware that the U.S.S.R. was capable of putting a satellite into orbit. In a press conference shortly after Sputnik's 1957 launch, Eisenhower attempted to reassure the American people, conceding that the Soviets had "put one small ball in the air," but quickly adding "I wouldn't believe that at this moment you have to fear the intelligence aspects of this." Later, his chief of staff Sherman Adams would liken the satellite launch to "one shot in an outer-space basketball game." What the Eisenhower Administration had underestimated was the deep almost visceral reaction Americans had to news of the satellite. It was disconcerting on two levels. First, it was clearly inconsistent with the prevailing notion that the Soviet Union was a technological backwater, incapable of matching the United States' economic or scientific prowess. Second, people were skeptical of Eisenhower's assurance that they had nothing to fear. Radio stations had broadcast the satellite's signal as it traveled over America and it seemed obvious that something that so easily violated transnational boundaries presented security risks.

During the ensuing media frenzy, the Eisenhower Administration would rethink its initial restraint. Clearly a major undertaking was needed to reassure the public that America, although second out of the gate, was not going to lose the space race. Change came quickly. Within a year Eisenhower would sign legislation creating the Advanced Research Project Agency, the National Aeronautics and Space Administration, and passing the National Defense Education Act, which allocated billions of dollars to helping students go to college to get degrees in math and science.

By 1961 when President Kennedy gave his famous speech about putting an American on the moon, U.S. outlays toward space flight and technology, a budget category that scarcely existed in the early 1950s, had already increased 10-fold from their 1957 levels. Altogether, from the launch of Sputnik to the moon-landing in 1969, U.S. outlays toward space technology would increase by almost 5,000 percent.

Dramatic in size and the speed with which they are enacted, spending "punctuations" of the kind described above are actually very common to government budgets. Look at almost any U.S. budget category for the last 50 years and you will encounter at least one massive adjustment, where the amount of money the government is spending changes by upward of 75 percent from one year to the next. These adjustments are not always toward increases in spending. Returning to the space flight example, NASA directors, triumphant over their recent successes, must have been chagrin in the early 1970s when, with the space race decisively won for America, politicians in Washington cut NASA's budget more than 50 percent. Budget instability works in both positive and negative directions.

What causes these punctuations? Further, why are punctuations non-constant across policy domains so that some policies persist, remaining the status quo for decades, while others undergo frequent adjustments? It is tempting to treat each punctuation as an isolated, one-off event. Surely, the best way to explain the dramatic increases in spending on science and technology in the 1960s is by reference to the Cold War and Sputnik. On a case by case basis, a historical approach may indeed be best, but the abundance of punctuations in budgetary time series demands a general causal explanation. Punctuations are endemic to the policymaking process, not rare, idiosyncratic events. Any attempt to characterize the nature of policy making in modern democracies must offer a systematic account of their existence. This dissertation

provides such an explanation by describing the causes of political instability. It focuses on the information processing capacity of governments and mass publics, which determine their ability to respond promptly and sufficiently to societal issues. The key finding is that instabilities vary substantially along two dimensions – the scope of governmental focus and the degree to which governments take a decentralized, or market-based, approach to decision-making. When governments are operating in comparatively simple policy domains or decentralize decision making, public policies tend to endure and change is a smooth, gradual process. When issues are complex or decision making is highly centralized, policy change is stochastic and punctuations abundant.

## Background

The first large-scale study to investigate the causes of political instabilities is *The Politics of Attention*, where Bryan Jones and Frank Baumgartner (2005) show that government spending follows a 'punctuated equilibrium' pattern of change. By this they mean that annual adjustments to government spending are predominantly small (ranging between -3 and 3 percent), but that occasionally the government undertakes enormous spending reallocations. This pattern is seen as a direct consequence of disproportionate information processing. The idea is that limitations to governmental attention inevitably cause over-attention to a relatively small number of items and under-attention to the bulk of issues that fail to cross some threshold of urgency and therefore gain attention. Over time, as issues rise and fall in urgency, individual and institutional attention shift not slowly and proportionately, but in jumps and starts. If policymaking follows the allocation of attention, then there will be incremental drift when attention is allocated elsewhere, as it is hard to justify a massive budget change in the absence of attention, and the possibility—though no certainty—of dramatic changes in those cases where attention is focused on a topic

where some urgency or crisis seems apparent.

By this logic, political instability can be closely linked to information processing. In a political system that processes information proportionally, there would be neither under nor over-attention to issues. Instead, issues would be addressed comprehensively, receiving attention in exact relation to the size of the underlying problem. As issues would not be ignored, or slip through the cracks, there would be no need for massive policy adjustments to correct issues that have worsened through inattention. Of course, a government that could process information at this high level is unlikely, even difficult to imagine. It comes as no surprise that the punctuated equilibrium pattern Jones and Baumgartner describe appears to be widely applicable, aptly characterizing the distribution of outputs from a wide variety of organizational decision making processes. In fact, the reasons to expect disequilibria are so strong that Jones and Baumgartner developed the General Punctuation Hypothesis (2005), which simply states that the outputs of any complex human decision making process will feature punctuations.

While fully proportional, or comprehensive, information processing may be unattainable we can still expect considerable variance across governments and organizations in their ability to process and respond to new information. The dissertation leverages this variance to interrogate the causal mechanism of the punctuated equilibrium framework. If policy instabilities result from attention scarcities, then when attention is less scarce, policy making should stabilize. This basic prediction has undergone little in the way of systematic testing. The General Punctuation Hypothesis provides a powerful explanation for an outcome (political instabilities), but rarely is applied to explaining variance in that outcome. Rather, the Hypothesis is based on a broad theoretical framework, the underlying mechanics of which have never been fully unpacked. That is the goal of this dissertation. To search for the limits of the punctuated equilibrium result by

identifying the conditions under which proportional, as opposed to punctuated, change is possible. In doing so, it seeks to provide a rigorous test of the applicability and explanatory power of the General Punctuation Hypothesis.

## What Does Information Processing Mean?

Information processing is a prerequisite of decision making and takes place over two distinct stages. The first involves receiving new information and the second requires comprehension of that information. Basic requirements for information processing are therefore: a) access to information b) time to consider the information and c) the expertise or intellect to comprehend the information. Individuals or organizations with a high capacity to process information easily meet the requirements. On the other hand, a low capacity to process information results from difficulty meeting one or all three requirements. For example, as individuals, we are often faced with decisions so complex that we lack the time to process all the potentially relevant information. Or we may be faced with a decision in an area where we have no prior experience, making it difficult to make sense of the information we are receiving.

One factor that clearly influences the information processing capacity of individuals or organizations is the scope of information that may be relevant to making a particular decision. Processing information relevant to simple tasks, such as deciding what to eat for breakfast, is not particularly burdensome and can be achieved at a high level by almost everyone. On the other hand, processing the information relevant to governing a country is more difficult by several orders of magnitude. Further, decisions are often required where there is no relevant information to begin with, or the available information is inaccurate. In these cases, uncertainty can cause individuals to pursue courses of action that are suboptimal given the reality of the issues at hand. In all, the capacity to process information will vary by individual, or organization, and from one

decision making process to the next.

A political system, as I use the term, refers to the combination of the mass public and the institutions within a country that affect political outcomes. Exploring the causes of instability in the U.S. political system requires accounting for the information processing capacity of both the government and the public. The chapter proceeds by reviewing literature that addresses the ability of the U.S. political system to meet each of the three information processing requirements. Next, I explain the logic and key findings of the punctuated equilibrium framework, including the empirical evidence and methods associated with the subfield. I conclude by presenting the theoretical contributions of the dissertation and outlining the chapters to follow.

## Accessing Information

Is relevant political information available to the government and public? An economic perspective would emphasize that, like any consumer good, information comes with costs. For individuals to be informed about politics they may have to subscribe to a newspaper or pay a cable subscription fee. In the Downsian account of democracy, information costs are a key driver of political inequality (Downs 1957). For its part, the government has clearly devoted considerable fiscal resources to information-gathering through the development of organizations such as the Congressional Research Service and Congressional Budget Office.

In fact, information is often plentiful and increasingly the costs of accessing quality information are shrinking, so finding time to sort through and prioritize information relevant to a decision is often more troublesome than accessing the information in the first place. In his 1996 *Participation in Congress*, Richard Hall writes that "policy-relevant information is abundant, perhaps embarrassingly rich, on Capitol Hill" (90). Even events that take the country by surprise

in retrospect often appear less random, even predictable. One of the more disturbing findings of the 9/11 Commission is that there was actually good evidence that a hijacking plot was in the works and that this evidence was available to the CIA. Of course, the advantage of hindsight is that we know how information should have been prioritized, but in the crush of current events critical information can be lost or ignored. It is often the case that too much, not too little, information is the problem.

## Considering Information

Access to information is the first step in information processing. For that information to be useful it must be prioritized. That is, institutions or individuals must be able to consider and deliberate over the information they have received. Consideration takes time and agenda space, both of which are scarce commodities. Herbert Simon, writing about governance, notes that "the environment makes parallel demands on the system, but the system can only respond serially" (1977, 157). In other words, problems requiring legislative action will often occur simultaneously and in no predictable or convenient order, but governments can only address them one at a time. Many scholars have remarked on the overwhelming complexity of governance and noted that national agendas tend to be limited to a few highly salient topics only, at the expense of many seemingly important issues (Sigelman and Buell 2004, Walgrave and Nuytemans 2009, Green-Pedersen and Mortensen 2010, Baumgartner et al. 2011). In many ways, governance is not a carefully planned endeavor, but a reactive enterprise with the pressing concerns of the day dominating the agenda.

Consider that during George W. Bush's presidency, we saw a major expansion of government through the creation of the Department of Homeland Security and, with the 2007 stimulus package, one of the largest government interventions into the economy in U.S. history.

Ideologically these are not actions typically associated with the Republican Party, but they were seen as reasonable, if not necessary, responses to the September 11th attacks and the 2007 financial crises. Agendas, carefully planned and promoted during elections, are quickly sidetracked by the demands of responsible governance, with particularly significant events, such as wars or recessions, occupying an inordinate amount of agenda space.

Beyond changing political and economic realities, to which parties must respond regardless of ideology, there are system-level factors that constrain political agendas. Much has been written about the institutional "rules of the game" and their effect on agendas. One clear example is the closed-primary system, which contributes to polarization and gridlock in Congress, therefore limiting the number of issues to which the government can attend. Other constraints include the dual-chambered legislature, congressional gatekeepers, the presidential veto, and a demanding election schedule (Bish 1973; Buchanan and Tullock 1962; Cox and McCubbins 2005; Koger 2006; Oleszek 2010). In each case, these factors limit the overall 'carry-capacity' of the system. For the most part, the U.S. government moves as it was designed to do by the founders: slowly.

A more ubiquitous agenda constraint is the limitations of human cognition. Jones and Baumgartner identify bounded rationality - basic constraints in the way people process and respond to new information - as the primary cause of disproportionate information processing. People may be rational in their pursuit of goals, but they have selective attention spans and limited short-term memories (Simon 1983; Thorngate 1988). To reconcile cognitive limits with a complex world, people develop heuristics whereby decisions are based on habit or underlying patterns (Margolis 1987). These heuristics are helpful cognitive short-cuts that allow people to bypass a great deal of non-essential information. Instead of processing and responding to all the

information that is relevant to a particular decision, people selectively weigh only a few key factors.

George Miller famously characterized the extent of the problem: "There is a clear and definite limit to the accuracy with which we can identify absolutely the magnitude of a unidimensional stimulus variable. I would propose to call this limit the span of absolute judgment, and I maintain that for unidimensional judgments this span is usually somewhere in the neighborhood of seven" (1956, 90). Put simply, Miller's point is that people can only process around seven unique stimuli at a time. In all, during any decision making process a great deal of pertinent information is never actively considered (Simon, 1947, 1999; Jones, 1994, 1999, 2001). For these reasons, finding the agenda space to attend to information can be seen as a more problematic requirement of information processing than accessing information in the first place.

## Comprehending Information

The challenge of interpreting so much diverse information is considerable and organizations develop strategies, both structural and procedural, to facilitate the task. An example from the U.S. Congress is the committee structure, which is designed to create niche areas of expertise. Not every member of Congress can be an expert on every issue, but by dividing attention across committees, collectively Congress can exercise proficiency on a wide range of topics. This kind of parallel-processing allows organizations to make many decisions routinely, without the need for comprehensive oversight. The U.S. government executes many decisions simultaneously by delegating the authority to make these decisions across various cabinet departments and congressional committees. To a limited extent, people are also capable of parallel-processing. Remember that Miller put the limits on cognition at around 6 individual stimuli, which leaves ample room for people to consider issues simultaneously.

Divisions of labor that allow for parallel-processing come with both financial and, in the case of the U.S. government many would argue, normative costs. One consequence is that members of Congress have incentives to form close relationships with interest group lobbyists who, having made a career working in a certain industry, have developed a great deal of specific knowledge, which they are happy to share with members. Together members of Congress and lobbyists will develop "policy subsystems" – small groups of political actors who monopolize the discussion over a particular issue (Griffith 1961; Redford 1969; Walker 1983; Chubb 1985). (Such arrangements are also known as iron triangles, policy networks, subsystem politics, and policy whirlpools.) The tendency for policy making to devolve into the purview of isolated subgroups has been seen as a problematic feature of modern democracy. If most policy decisions are made behind closed doors, with little public input, it raises questions about whose interests are being represented by government (Schattschneider 1960). Policy subsystems can be seen as a direct and inevitable consequence of a system that requires the comprehension of a vast array of information. If running the national government were less complicated, there would be no need for the divisions of labor that encourage subsystem development.

Parallel-processing allows organizations to skirt the limits of attention, but at some point those limits will be confronted. Bureaucracies are designed to process routine decisions, but major new initiatives or decisions about controversial topics will have to be decided by a central governing authority. This is when organizations shift from parallel to serial-information processing, as responsibility for making decisions moves from multitudes of bureaucratic employees to a much smaller subset of organizational leaders. In other words, this is when agenda setting takes place. The U.S. government, for example, makes thousands of decisions routinely, but implementing new public policy or redirecting bureaucratic focus requires

centralized decision-making, either by the President or party leaders in Congress. At this point, the cognitive limits of people in leadership positions come into play. In sum, attention can be stretched by bureaucratic divisions of labor, but only so far. Even for complex organizations, attention is a scarce commodity.

## Punctuated Equilibrium

What happens in a political system where attention can be allocated to only a very small subset of issues at any given time? What will policy change look like? McCubbins and Schwartz (1984) popularized the term "fire-alarm oversight" to characterize the nature of governance under conditions of attention scarcity. The idea is that policymakers only have time to deal with crises. Anything less than a full-blown crisis and the issue will be left off the agenda, as in most modern societies there are enough crises to fully occupy the government's limited attention. Of course, there are many issues that might not rise to crisis-level, but would still benefit from government attention. These issues will be ignored, and worsen through inattention, until they become crises in their own right. Note that there is nothing objective about assigning urgency to some issues over others. History is full of examples where governments took unprecedented steps to alleviate a perceived crisis that in retrospect looks trivial or nonexistent. Likewise, some contemporary issues look very urgent, but are still being ignored. Regardless of the selection mechanism, because agenda space is limited, issues must displace each other as they rise and fall in urgency.

Crises demand action, so when issues do make it on the agenda there is the potential for major policy adjustments. There is also the possibility that government deliberations end in gridlock and nothing will be accomplished, no matter how dire a situation appears. Even with attention, policy change is no certainly. Still, the likelihood for major changes is greater where

attention is focused. Absent any attention, it is hard to imagine how or why large shifts would be enacted. This dichotomy, or threshold effect, is the basis of the punctuated equilibrium model. Without attention, policies change only marginally from year to year, but when attention is focused policy punctuations are possible.

The punctuated equilibrium model was originally developed to explain policy change at the national level, but the model's theoretical roots are grounded in a basic understanding of human cognition. Certainly attention can be considered an important prerequisite for change in many contexts and taking the implications of bounded rationality seriously suggests attention scarcities are widespread. This led Jones and Baumgartner to formulate the General Punctuation Hypothesis, which predicts that the result of any complex human decision making process will be punctuated. A broad prediction, subsequent scholarship has supported the hypothesis, finding evidence of disequilibria across a wide range of political time series, including congressional hearings, bill passages, media coverage, and the budgets of city and local governments (Jordan 2006; Breunig and Koski 2006; Jones et.al. 2009; Boydstun 2013).

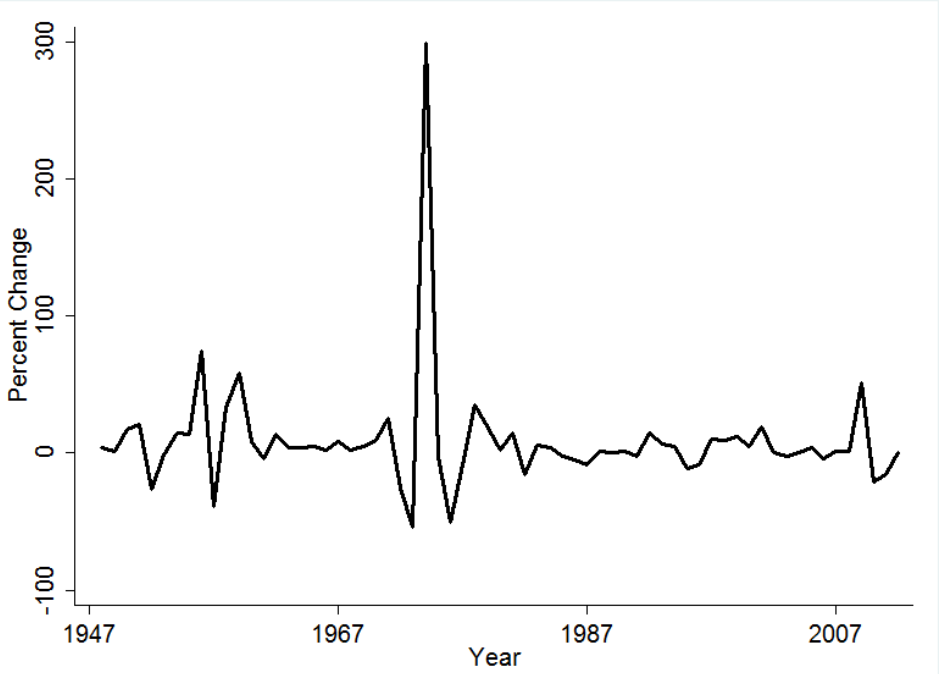
## Empirical Methods

The punctuated equilibrium model was originally developed and tested using a historical, case-study approach. The strategy was to track policy changes to individual topics over time in order to illustrate the agenda dynamics thought to cause policy punctuations (Baumgartner and Jones 1993). Today the literature emphasizes a distributional, or stochastic approach, which rather than asking why an individual policy series saw a punctuation, focuses on identifying aggregate patterns of change across time and multiple issues domains. Conclusions drawn from this literature have tended to be sweeping in scope, characterizing the nature of policy making at the broadest level. Testing a broad hypothesis requires expansive data and a common focus in the

literature is government budgets, which provide a good approximation of the relative importance governments place on different issues. The added benefit is that for many Western democracies budget data is plentiful, facilitating international comparison.

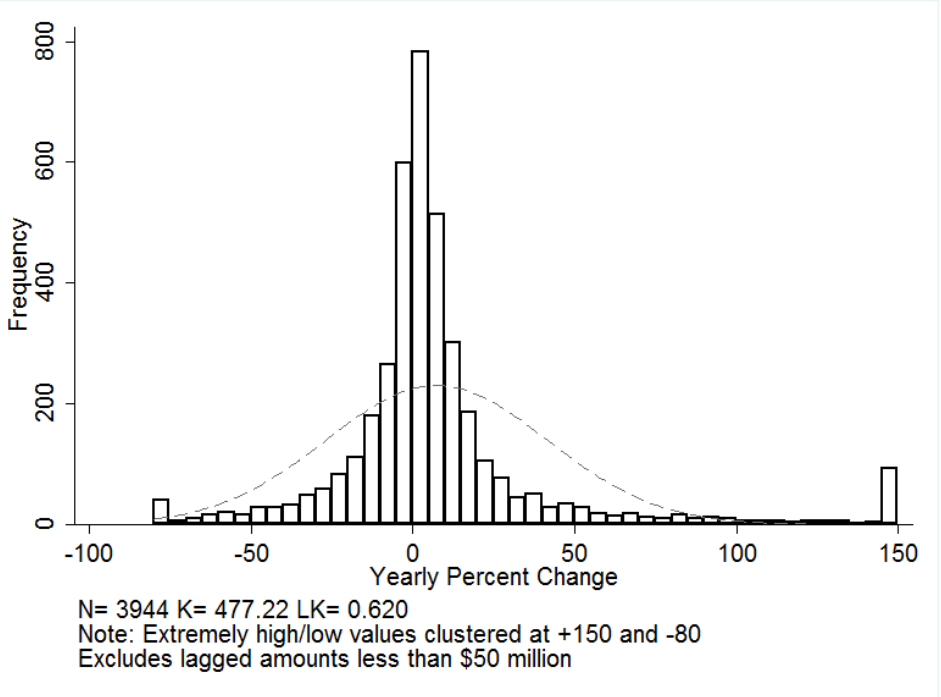
What does a punctuated equilibrium pattern of change look like? Figure 1.1 shows annual percentage changes in spending on public transportation by the federal government, from 1947 through 2012. There are substantial reallocations in the early 1950s, corresponding to development of the interstate system by the Eisenhower Administration, but clearly all other changes are dwarfed by the reallocation that took place in 1974. Seen as a means of combating urban blight, the Community Development Block Grant program was signed into law by President Ford after receiving bipartisan support in Congress. A major component of the program was to develop public transit systems, allowing residents in poorer neighborhoods to commute to jobs in more affluent urban centers. From one year to the next federal transportation outlays increased by over 300 percent. Usually transportation is not seen as a particularity pressing issue, but in the early 1970s it was momentarily viewed as a solution to what, at the time, was considered a serious problem.

Figure 1.1. Percent Change in Federal Transportation Outlays, 1947 – 2012




Of course, the federal government allocates money to many different programs besides transportation. Figure 1.2 shows the distribution of annual percentage changes in spending across all 67 Office of Management and Budget (OMB) categories (called subfunctions in OMB parlance), from 1947 through 2012. This is a simple update of the Jones-Baumgartner figure 4.14, which started the discussion about punctuations in budgets (2005, 111).

Figure 1.2. Distribution of Annual Percentage Changes Across OMB Subfunctions, 1947 – 2012



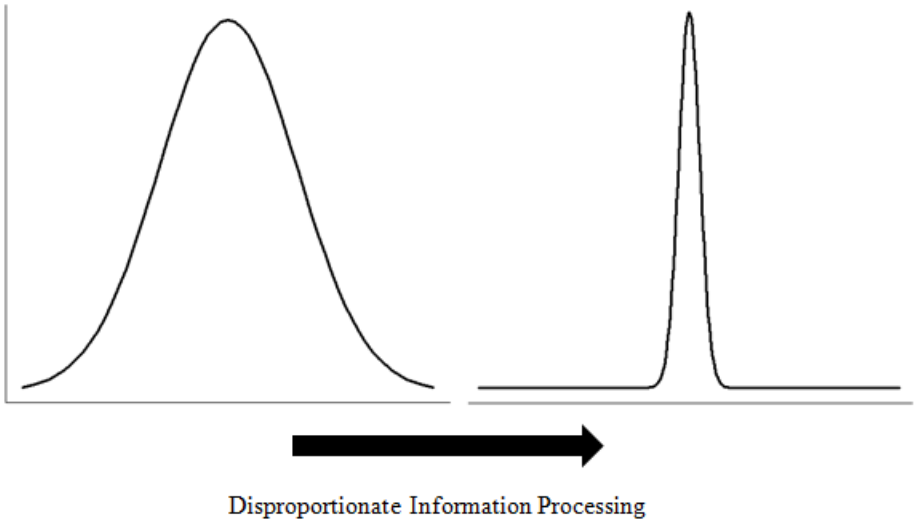

Clearly this distribution is not normal, but instead can be described as leptokurtic. (Superimposed over the budget distribution is a normal distribution, for comparison.) Leptokurtic change distributions are considered a key indicator of a government that is processing information disproportionately. This type of distribution has much wider tails and higher central peaks than would be produced by a normal data-generating process, and the "shoulders", or mid-range changes, are missing. The high central peak is caused by widespread under-attention to issues, which leads to incremental budgeting, and the wide tails result from decisive government reallocations on issues where there is a sense of urgency. The l-kurtosis statistic measures the degree to which a distribution displays leptokurtosis. A normal distribution has an l-kurtosis of 0.123, with increasing values indicating leptokurtosis and lower values playkurtosis. Note that the budget distribution in the figure has an l-kurtosis value of around 0.620, indicating that it deviates substantially from the Normal (Jones et.al. 2009).

Based on the huge range of activities that might occupy a national government, the

punctuated equilibrium model assumes that annual changes to the overall inputs associated with governing are normally distributed, from the Central Limit Theorem. In this way the budget distribution tells us something about how efficiently the government is at processing and responding to problem, as we can expect that a perfectly efficient government would adjust spending proportionally to inputs, thus generating a normal spending distribution.

The dissertation employs a multitude of methods, but a key analytic approach will be to compare the shape of output distributions. If punctuations result from attention scarcities, then in conditions where attention is less scarce, output distributions should trend toward the normal. Figure 1.3 illustrates the expected dynamic. When attention is scarce and narrowly focused the dichotomy between marginal drift and policy punctuations should be especially acute; corresponding to a higher central peak and wider tails. As information is processed more proportionally, organizational outputs will more closely resemble the distribution of relevant inputs, which is assumed to be normally distributed.

Figure 1.3. Relationship between Information Processing and Output Distributions




The empirical scope of the dissertation is broad, with data from the 1940s through 2012 on a variety of government, public, and corporate outputs, but the focus is narrow. With each

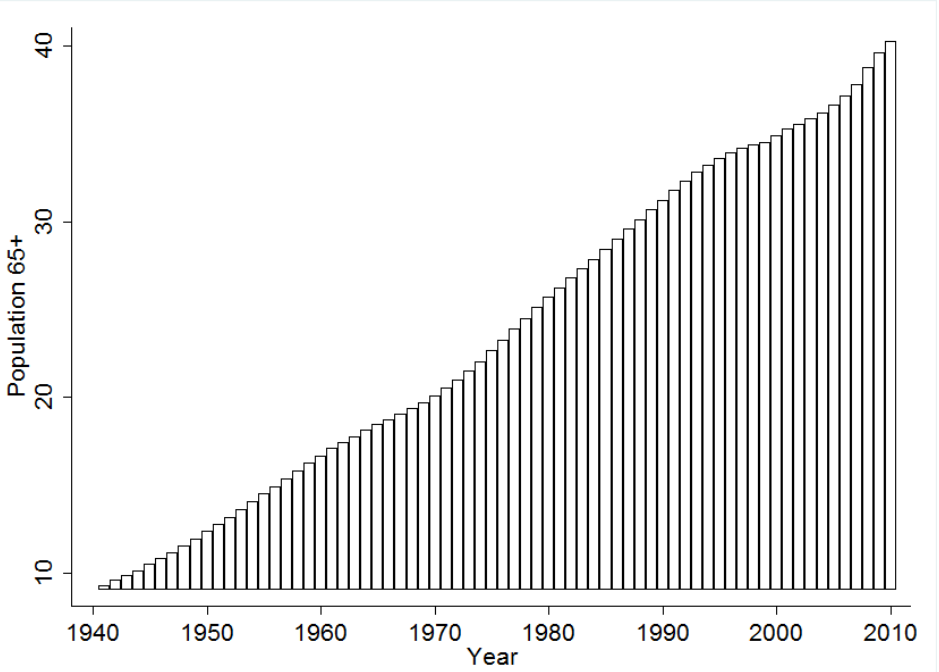
dataset, hypotheses are derived and tests conducted to determine how political instability varies with attention.

## Theoretical Expectations

Given what we know about information processing and how it affects policymaking, what factors are most likely to condition the stability of organizational outputs? That is, what factors will be the biggest contributors to punctuations? The preceding scholarship offers some clues. First, returning to studies on bounded rationality, while there are clearly upper limits to human cognition, there are also lower limits. If it takes 6 or more stimuli to overwhelm human cognition, forcing people to fall back on heuristics, where decisions feature fewer than 6 alternatives, people should be able sort through those alternatives in a fairly comprehensive manner. At issue, in other words, is complexity. When decisions are very simple, comprehensive information processing is not so prohibitive.

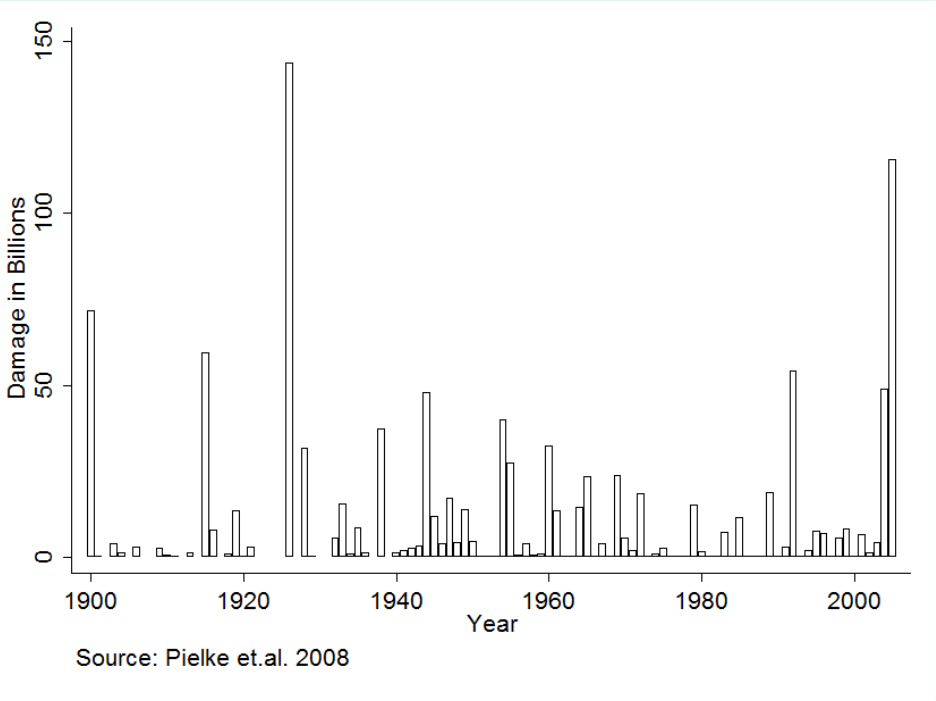
Granted, 6 is a low number given the diversity of issues faced by modern governments. Policymakers in Washington are obviously confronted with many more than 6 issues to worry about at any given time, so it seems unlikely that we will ever observe a government that processes information comprehensively across the board, even with bureaucratic divisions of labor. Still, we can expect considerable variance in the degree to which complexity will be at issue across policy domains. I take a two-pronged approach to understanding complexity. The first dimension is "natural" or real-world complexity, which simply acknowledges that some policy domains are by nature less complicated than others. Social Security payments, or other forms of "old-age insurance", are based on changing age demographics, for example. Figure 1.4 gives an example, tracking in millions the number of people in the U.S. age 65 or older, from 1940 through 2010.

Figure 1.4. U.S. Population Age 65 and Older




As an indicator, age demographics are as well-behaved as a policymaker could ever hope for and determining outlays for policies linked to changing demographics should be relatively straightforward. Contrast Social Security with policy domains related to disaster relief or farm price supports, where the relevant inputs are highly stochastic. Figure 1.5 shows normalized hurricane damages in the U.S., from 1900 through 2005. While age demographics showed a clear, steadily increasing trend, there is no apparent trend with hurricane damages. Instead, the size of the damage fluctuates widely from year to year.

Figure 1.5. Normalized Hurricane Damages




If climate models were vastly superior, then policymakers might have forewarning about particularly powerful hurricanes years in advance, allowing them to budget for these disasters incrementally. Of course, the complexities of weather events are such that accurately predicting next week's weather is challenging; to say nothing of predicting specific hurricanes years before they happen. Faced with such complexity, what do policymakers do? They cross their fingers and hope that no major disasters take place on their watch and when a disaster does occur, they allocate spending to address the crisis. We can consider instability that results from natural complexity to be reactive, in the sense that policymakers are forced to quickly respond to an unforeseen, or newly discovered, crisis.

The other type of complexity is political in origin. This dimension acknowledges that there are no true equilibria in politics. Rather, there are various problems in search of solutions and solutions in search of problems (Kingdon 1984; Cohen et.al. 1972). As political conflicts play out, problems and solutions will pair off, creating status quos that may endure for decades,

but are ultimately fragile. When new ideas or issue frames come to dominate thinking about a particular problem, large policy changes can result, as the government readjusts its focus. This type of complexity, famously described by Kingdon's "three streams approach", is a major focus in the agenda setting literature.

As discussed, given institutional constraints and the restrictive boundaries of human cognition, finding a government that comprehensively processes all the information relevant to policymaking is unlikely. But the General Punctuation Hypothesis makes claims beyond just the public sector, predicting that the results of any human decision making process will be punctuated. Might there be organizations whose focus is so narrow that they can effectively process all the information relevant to their decision-making processes? It is an open question (one that the dissertation will pursue), but it seems likely given the wide range of organizational interests in today's society.

Another factor that might powerfully affect the stability of organizational outputs is the degree to which organizations employ a decentralized, or market-based, decision-making process. Jones, Sulkin, and Larsen (2003) showed that distributions of changes in stock market returns were approximately normal. Markets returns are a common, and much lauded, product of human-decision making, so this finding represents an important caveat the General Punctuation Hypothesis. The hypothesis applies only to the outputs of people or organizations operating in isolation. Once we start aggregating across autonomous decision-making units, outputs appear to stabilize and punctuations become much less frequent. Why should this be the case? What is the distinction between market-based and centralized decision making?

Jones et.al. emphasize that modern stock markets are characterized by relatively low transaction and information costs, so the institutional constraints imposed by markets are

considerably less than those seen in government. Most important, however, is that markets gain by aggregation. Each individual actor in a market system has an effect on the final outcome, so idiosyncratic or random behavior by actors who are uninformed averages out, leaving a clear, sophisticated signal from the actors who are reacting to some common stimuli. There is, in other words, a powerful empirical reason why market systems are better at processing information than individuals.

For illustration, imagine that every day some investors sell their shares in a certain stock for various personal reasons; perhaps they have a major purchase on the horizon. Conversely, other people may decide to diversify their investments and purchase the stock. Since this behavior is random, it will average out, with the people buying new shares making up for the deficit caused by people who sold their shares. Now imagine that the company selling the shares announces that quarterly revenues were lower than expected. This sends a strong signal to investors that the company is not performing as well as hoped, that perhaps more bad news is on the horizon, and that it might be time to devest. This is an actual signal, not random noise, so we can expect it will not average out, but instead cause share prices to immediately adjust to a lower level. If we were to sample any random person's decision making process in regard to buying or selling the stock, it is unclear what we would find. Idiosyncrasies abound, and it is always possible that the person in question was not paying attention and missed the signal altogether, in which case there is no reason to expect the person will do anything at all. Likewise, looking at any single organization in isolation, various political or institutional conditions will affect the way that organization interprets signals, or as is often the case with national governments, signals will become lost in the tidal wave of incoming information.

The ability of markets to process information at a very high level is well-known and often expressed in terms of the "efficient-market hypothesis", which asserts that it is almost impossible to consistently 'beat' average market returns because prices on traded assets already reflect virtually all the information relevant to buying or selling (Samuelson 1965; Fama 1970). This does not mean markets are infallible – they do not operate with perfect information and a 'herd-mentality' can occasionally lead to speculative economic bubbles (Basu 1977). Still, while the degree to which markets are perfectly efficient is debated, we can reasonably expect that an open market system will process information more completely than isolated organizations.

Markets are certainly a central part of social life in modern democracies. What about the role of market-based decision making within government? To what extent are market mechanisms used to determine policy outcomes? In fact, market structures are not uncommon to policymaking. Much of monetary policy, a substantively important component of governance, is based on market interactions, and many social policies also feature market components. A recent example is the Affordable Care Act, which establishes a marketplace to determine the price of health insurance. We can expect that policies where outcomes are generated by a market will see fewer punctuations than those where outcomes are determined exclusively by a central decision-making unit.

In sum, there are good reasons to think that these two factors –complexity and the centralization of decision-making – will powerfully predict the stability of political outcomes. The dissertation proceeds to test this reasoning as follows: Chapter 2 revisits the federal budget, the focus of Jones and Baumgartner's original work, to investigate the specific causes of punctuations in budgetary outlays. The emphasis in this chapter is on spending inputs and how different budget functions are linked to very different indicators. Some inputs generate

dependable and stable information flows, while others are much more erratic, so the occurrence of disequilibria in the federal budget is not constant but varies by spending type. By directly measuring the distribution of inputs relevant to particular areas of policymaking, the chapter avoids making assumptions about how those inputs may be distributed, allowing for a more direct testing of the General Punctuation Hypothesis. This exploration informs the specification of a logistic regression model and a key contribution is to predict the occurrence of punctuations in budgetary time series.

Informed by these results, Chapter 3 investigates the robustness of punctuation equilibrium theory as an explanation for instability in public budgets. It explores potential artifactual causes of punctuations, controls for them, and revaluates distributions of budget data when they are eliminated from the analysis. A key theoretical development is to distinguish between punctuations that are sustained over many years, versus those that frequently reversed. Using U.S. federal budget data as the test case, I find only small differences in the shape of spending distribution when budget series prone to temporary punctuations are eliminated.

Chapter 4 expands the scope of the analysis to the 50 states and looks at revenue policies. The availability of revenues can obviously be an important input when making policy decisions. Meanwhile, an important input to revenues is the underlying economy, I measure through GSP. The chapter considers: a) how instability in revenues streams lead to punctuations in outlays b) how the difficulty of decision-making processes can affect the shape of output distributions c) how the composition of tax portfolios affects the stability of revenue distributions.

Chapter 5 develops an information processing model for mass publics. Analysis of public opinion data developed by James Stimson (1991) reveals that changes in public opinion closely match a punctuated equilibrium pattern of change. Applying the concept of bounded

rationality to mass publics suggests that public attention is a scarce and disproportionately allocated commodity. Causal analysis of opinion data in relation to media coverage finds that large shifts in opinion are much more likely when attention is highly concentrated, but for the many issues where attention is absent, opinions drift only marginally. Public opinion is very much a 'sleeping giant' – predominantly static and at the same time prone to sudden and dramatic bursts.

Chapter 6 looks at corporate and market data to determine the applicability of the punctuated equilibrium framework to the private sector. Conventional wisdom is that the private sector is much more efficient than government. This chapter explores how this is and is not true. Markets, based on the collective actions of millions of people, are highly efficient, but corporations work under the same cognitive constraints as governments (or any other organization). A comparison of exchange rates across countries using fixed and free-floating rates illustrates this point, as does consideration of the Regional Greenhouse Gas Initiative adopted in some Northeastern states, and the price of air fares before and after deregulation of the airline industry.

## CHAPTER TWO: PREDICTING PUNCTUATIONS

Scholarship shows instabilities in outputs from governments around the world, but the original finding was for the U.S. national government. This is where the dissertation's search for variance begins. It is well-understood that aggregate changes to U.S. government policies display frequent punctuations, however, this general finding masks what may be considerable variance across policy domains. There is no reason to expect that the government will process information in the exact same way, or with the same aptitude, across domains as diverse as Social Security is to emergency management. Part of the methodology of this chapter will be an attempt to directly measure various inputs that may be relevant to the policymaking process in order to determine if instability in the inputs is associated with more punctuations in the outputs, as would be expected.

Studies in agenda setting have for the most part avoided measuring inputs directly, instead relying on the assumption that they will be normally distributed in the aggregate. This avoidance is due primarily to uncertainly as to what the appropriate inputs are; the decision-making theory at the core of punctuated equilibrium is that decision-makers are never using a complete model of reality, and therefore that they may occasionally update their approach. This means changing the series of input indicators they consider relevant to a particular issue. Further, many of the indicators decision-makers may use will be qualitative and informal.

Still, there are clear limitations to the general approach. It necessitates drawing conclusions at only the highest levels of aggregation, as the assumption of normally distributed inputs breaks down when looking at specific policies. The result is a "black box" at the center of

the punctuated equilibrium framework - inputs into a political system are acted upon by cognitive and institutional limitations, resulting in punctuated outputs. But where exactly do those punctuations come from? Some areas of policy making might be more prone to instability than others. Some governing conditions, such as single party government, may result in punctuations more frequently than periods of divided control. How much of the instability observed in the federal budget can be attributed to political complexity caused by deliberations over the merits of competing inputs, versus natural complexity that the government simply reacts to? These questions motivate this chapter's approach: a return to the U.S. federal budget with the goal of unpacking the black box at the center of the punctuated equilibrium model. In doing so, it offers an extension of the model, by describing the occurrence of punctuations over a range of policy domains and conditions, but also a test. Without a firm measure of underlying inputs, a key finding in the literature is based on an assumption (albeit a strong one). The chapter, by directly measuring inputs, allows a side-by-side comparison of input and output distributions, providing a direct test of the General Punctuation Hypothesis.

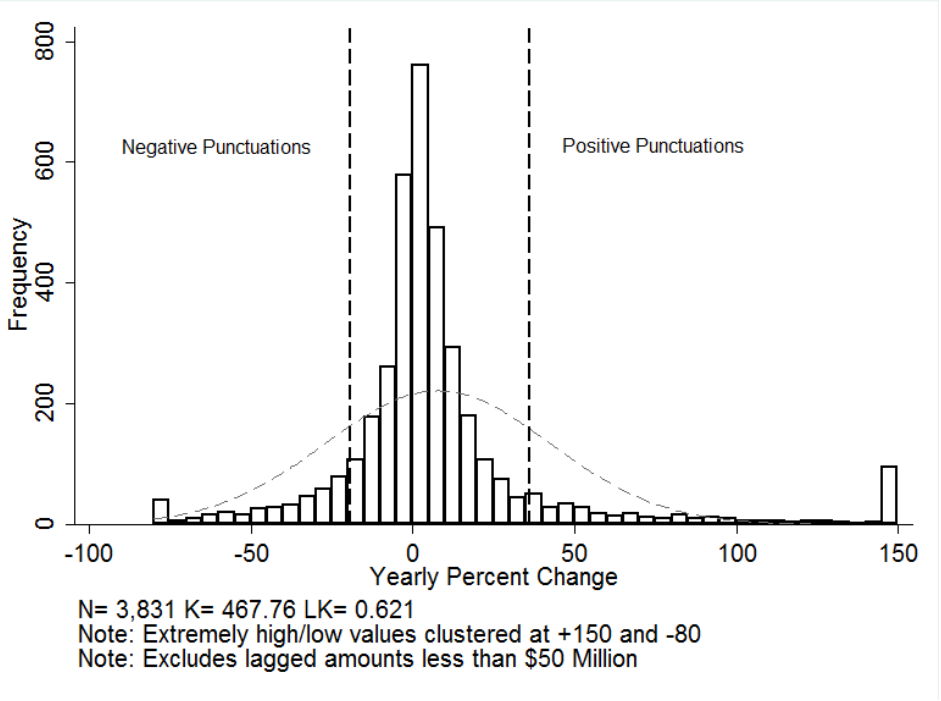
## Budget Punctuations – The Dependent Variable

The analysis takes place over two sections. The first develops and tests various hypotheses relating to the occurrence of punctuations in U.S. outlays. Data for this analysis comes primarily from the Policy Agendas Project, which provides Office of Management and Budget datasets that track government outlays across various budget categories (subfunctions in OMB parlance) from 1947 to 2012. The analysis also uses a highly detailed budget document available from the Bureau of Economic Analysis (BEA), which breaks outlays down by the government agency authorized to spend the allocated money. The second section develops a model to predict the occurrence of budget punctuations using logistic regression.

Before proceeding to subsequent analysis the chapter establishes a definition for what constitutes a budget punctuation. Figure 2.1 shows aggregate changes in government spending across OMB subfunctions from 1947 to 2012, repeating Figure 1.2 from Chapter 1. The goal here is to explain the punctuations in Figure 2.1 and there are various ways to distinguish between those cases far in the tails and those not considered to be punctuations. Analysis of the causes of punctuations proves to be highly robust with respect to where the line is drawn between a punctuated change and one that is closer to the bulk of the observations. For simplicity, I draw that line at the top and bottom ten percent of the observed changes, and the figure illustrates this with vertical lines. With 3,831 observations in the overall distribution, 783 then are identified as punctuations, half on the negative side and half on the positive side. Note, as is standard in the literature, the presentation of the data is truncated by clustering all extremely high positive changes at +150 percent and negative changes at -80 percent.[1]

[1] More complicated definitions of what constitutes a punctuation, such as those beyond the point where the observed distribution passes the hypothetical Normal distribution with similar variance, or controlling for changes in overall variability across time, generate results highly similar to those we present here, so for simplicity, but with knowledge that our results are robust, we choose a very simple definition of punctuation here. Various authors have drawn these lines differently: Jones, Baumgartner and True (1998) drew them at +20 and -15; Breunig and Koski (2006) have used quintile regression to analyze separately the tails from the center of the distribution.

Figure 2.1. Identifying Punctuations in the Distribution of Annual Changes in Federal Outlays




How are the punctuations in Figure 2.1 distributed across policy domains? Christian Breunig and collaborators showed strong differences in levels of punctuation across policy domains in the U.S. federal budget (with l-kurtosis scores ranging from 0.2 for interest on the public debt to 0.6 for Medicare) and the Danish national budget (with l-kurtosis scores ranging from close to zero for welfare and 0.6 for waterways). Further, they showed that for the cases where the budgets could be compared, the same issue-domains tended to have low or high l-kurtosis scores in both countries (Breunig, Koski, and Mortensen 2010). Finally, Breunig and Koski (2012) showed similar results looking at a different set of policy comparisons in the 50 US states (and also when comparing annual budget totals from state to state); they found education spending to be at the low end of the l-kurtosis scale, with parks at the top.

The chapter follows the general pattern of Breunig et al. (2010) here and simply lists, by U.S. OMB subfunctional category, the number of positive, negative, and total punctuations in the budget series, using the same data from Figure 2.1 above. Recall that by definition there are 392

positive, and 391 negative punctuations. Here, we see that topics driven by exogenous shocks tend to have the most punctuations (disaster relief, farm support), while those topics associated with mandatory programs have fewer (Social Security, Medicare).

Table 2.1. Punctuations by OMB Subfunction

| OMB Subfunction | Positive Punctuations | Negative Punctuations | Total |
|---|---|---|---|
| Disaster Relief and Insurance | 21 | 22 | 43 |
| Military – Other | 16 | 19 | 35 |
| Farm Income Stabilization | 14 | 19 | 33 |
| General Property and Records Management | 16 | 16 | 32 |
| Other Advancement of Commerce | 13 | 16 | 29 |
| Other General Government | 13 | 13 | 26 |
| Veterans Education, Training, and Rehabilitation | 9 | 18 | 26 |
| International Security Assistance | 12 | 14 | 26 |
| Community Development | 13 | 12 | 25 |
| Higher Education | 15 | 10 | 25 |
| Housing Assistance | 12 | 12 | 24 |
| International Development and Humanitarian Assistance | 13 | 11 | 24 |
| Area and Regional Development | 9 | 15 | 24 |
| Unemployment Compensation | 12 | 9 | 21 |
| Training and Employment | 12 | 9 | 21 |
| Defense-related Activities | 12 | 9 | 21 |
| Criminal Justice Assistance | 8 | 9 | 17 |
| Ground Transportation | 8 | 7 | 15 |
| General Purpose Fiscal Assistance | 7 | 7 | 14 |
| Research and General Education Aids | 7 | 7 | 14 |
| Emergency Energy Preparedness | 5 | 9 | 14 |
| Water Resources | 5 | 8 | 13 |
| Elementary, Secondary, and Vocational Education | 7 | 6 | 13 |
| Space Flight, Research, and Supporting Activities | 9 | 4 | 13 |
| Military Construction | 4 | 9 | 13 |
| Pollution Control and Abatement | 6 | 6 | 12 |
| General Retirement and Disability | 4 | 7 | 11 |
| Atomic Energy Defense Activities | 6 | 5 | 11 |

| | | | |
|---|---|---|---|
| Conservation and Land Management | 5 | 6 | 11 |
| Executive Direction and Management | 7 | 4 | 11 |
| Recreational Resources | 7 | 4 | 11 |
| General Purpose Management | 5 | 5 | 10 |
| Energy Information, Policy, and Regulation | 3 | 7 | 10 |
| Energy Conservation | 3 | 7 | 10 |
| General Science and Basic Research | 7 | 3 | 10 |
| Air Transportation | 5 | 4 | 9 |
| Social Services | 6 | 2 | 8 |
| Health Care Services | 5 | 3 | 8 |
| Conduct of Foreign Affairs | 4 | 4 | 8 |
| Food and Nutrition Assistance | 7 | 0 | 7 |
| Other Labor Services | 2 | 5 | 7 |
| Federal Law Enforcement Activities | 4 | 2 | 6 |
| Federal Employee Retirement and Disability | 3 | 2 | 5 |
| Other Veterans Benefits and Services | 3 | 2 | 5 |
| Water Transportation | 2 | 3 | 5 |
| Legislative Functions | 3 | 2 | 5 |
| Military (1947-1956) | 2 | 2 | 4 |
| Military Family Housing | 0 | 4 | 4 |
| Federal Correctional Activities | 3 | 1 | 4 |
| Other Natural Resources | 3 | 1 | 4 |
| Foreign Information and Exchange Activities | 0 | 3 | 3 |
| Income Security for Veterans | 2 | 1 | 3 |
| Other Transportation | 1 | 2 | 3 |
| Consumer and Occupational Health and Safety | 2 | 0 | 2 |
| Health Research and Training | 1 | 1 | 2 |
| Agricultural Research and Services | 0 | 2 | 2 |
| Military Research, Development, Test, and Evaluation | 2 | 0 | 2 |
| Central Fiscal Operations | 1 | 1 | 2 |
| Social Security | 1 | 0 | 1 |
| Medical Care for Veterans | 0 | 1 | 1 |
| Federal Litigative and Judicial Activities | 1 | 0 | 1 |
| Military Operations and | 0 | 1 | 1 |

| | | | |
|---|---|---|---|
| Maintenance | | | |
| Medicare | 1 | 0 | 1 |
| Military Procurement | 1 | 0 | 1 |
| Other Income Security | 0 | 0 | 0 |
| Military Personnel | 0 | 0 | 0 |
| Total | 392 | 391 | 783 |

Table 2.1 provides reassurance on two counts: first, that there is considerable variance in the occurrence of punctuations across budget categories to explain, and second that complexity is a plausible avenue for exploring that variance. Figures 1.4 and 1.5 from Chapter 1 looked at annual changes to age demographics and hurricane damages, making clear that some inputs series are much less stable than others. It therefore is not no surprising in Table 2.1 to see that budget categories based on age demographics have the fewest punctuations, while spending on disaster relief and insurance has the most. I turn to a series of considerations of the conditions where we might see more and fewer punctuations, with the aim of developing a relatively fully specified model of instability in budgetary time series.

## Honeymoons, Learning, and Government Control

One obvious possibility for the presence of dramatic policy shifts is change at the top. New presidents, especially those with a different ideology from their predecessors, might want to make their stamp by dramatically adjusting spending patterns. The chapter looks at this in two ways: first, by considering whether new presidents, eager to live up to campaign promises, usher in large budgetary changes shortly after taking office. If presidents benefit from a honeymoon period, they may be uniquely able to make these larges changes during their first year or two in office (Eshbaugh-Soha 2005; Lockerbie, Borrelli and Hedger 1998; Pfiffner 1988; Beckmann and Godfrey 2007). Second, it considers the learning hypothesis, which suggests systematic changes in the likelihood of punctuations over the years of a president's tenure in office.

According to the learning hypothesis, presidents can be expected to achieve greater legislative success later in their terms, as they have more experience with the office and negotiating with Congress (Neustadt 2001; Light 1999). Table 2.2 looks at the honeymoon idea and Figure 2.2 considers the learning hypothesis.

Table 2.2. Punctuations in the First Budget Year of a Presidency

| Budget Year | N | % Pos. Punctuations | T-test | % Neg. Punctuations | T-test |
|---|---|---|---|---|---|
| First Budget Year | 667 | 8.85 | 1.25 | 13.04 | -2.71* |
| Subsequent Budget Years | 3,184 | 10.46 | | 9.55 | |
| Total | 3,851 | 10.18 | - | 10.15 | - |

* = significant at 0.05 p-value

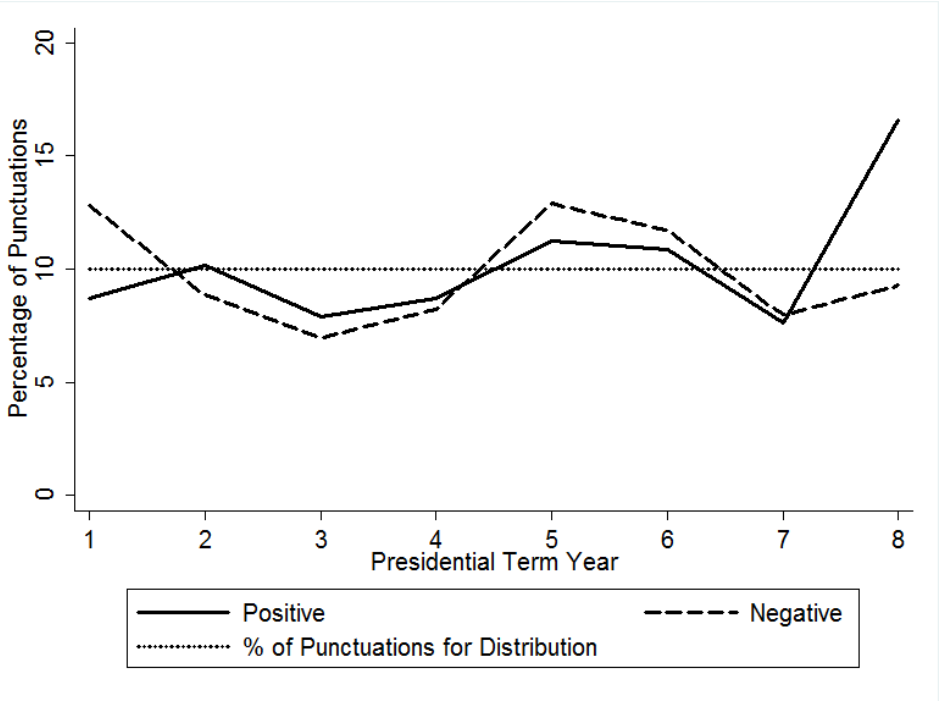
If new presidents were systematically making their mark in the first year when they had the opportunity to do so, there should be a high percentage of budget punctuations in that first year. Table 2.1 provides some support for this idea, showing that negative punctuations are slightly more common in a president's first budget[2]. Positive punctuations, however, are slightly less likely, although not to a statistically significant degree. This suggests that new presidents are more inclined to make dramatic cuts to the budget during their first year in office than increases; perhaps in an effort to reverse policies associated with their predecessor. Will Jennings and Peter John (2010) explored a similar idea using the British speech from the throne, finding that speeches from new Prime Ministers immediately following their elections were somewhat more likely to show large differences from the previous year's speech. The analysis offers modest support for their finding in the U.S. context.

What about subsequent years in office? Do presidents learn on the job? If presidents become more adept at working with Congress during their time in office, punctuations may be

[2] President term years are lagged in this analysis so that budgets correspond with the presidents that authorized them. For example, a president elected in 2008 takes office in 2009 and submits his first budget to take effect in FY 2010. The analysis count 2010 therefore as the "first year" for the purpose of these comparisons.

more likely toward the end of a presidential term. Another possibility would be that second-term presidents are less risk adverse and more willing to sign their names to major policy initiatives. Figure 2.2 shows the percent of budget changes falling in the positive and negative tails of the overall distribution, by presidential year. That is, for all presidents, the figure looks at the occurrence of punctuations as a percentage of total reallocations in their first, second, third year in office, and so on.

Figure 2.2. Rate of Positive and Negative Punctuations by Year of Presidential Term




By definition, 10 percent of all budget reallocations are negative and 10 percent positive punctuations. The figure shows that there is little fluctuation around this average, with all the values falling between seven and seventeen percent, but no strong trend in any direction. In particular, there is no evidence of steady growth over time, which would be consistent with the learning hypothesis. If anything, there is a slight inflection during the eighth year of a president's term in the percentage of positive punctuations. This compliments Table 2.2, which showed that

positive punctuations are more likely after a president's first budget. Overall though, there does not appear to be any major trend in punctuations associated with presidential term year.

Another factor that might influence the occurrence of punctuations would be single party control of government. Majority parties under unified governments enjoy greater degrees of in-party cooperation and institutional leverage, which afford them greater success in implementing their legislative agenda (Cox and McCubbins 1991, Aldrich 1995, Coleman 1999). Further, periods of unified government may present majority parties with opportunities to pursue major policy initiatives; operating as a "release-valve" on pent-up issues that went unattended through political intractability. In turn, divided government imposes greater transaction costs on the president's party, which can limit its productivity. Table 2.3 shows the occurrence of punctuations across three levels of party control – divided and unified government, and unified government with a filibuster-proof majority in the Senate (the highest level of party control possible).

Table 2.3. Punctuations by Party Control

| Government | N | % Punctuations |
|---|---|---|
| Divided | 2,324 | 18.79 |
| Unified | 1,527 | 21.85 |
| Unified & Filibuster Proof | 591 | 21.63 |

The table shows a slight increase in the percentage of punctuations as party control solidifies. However, even during unified government with a filibuster-proof majority in the Senate, the budget is only 3 percent more likely to see an extreme change than during periods of divided government. In all, the evidence that either party control or presidential term year affect spending punctuations is somewhat limited. This suggests the ability of majority parties to implement sweeping reforms is highly constrained, regardless of governing conditions. In other words, punctuations seemingly have little to do with varying levels of party control. In contrast,

Table 2.1 showed that punctuations vary substantially across budget categories. It would seem that the roots of variance in the instability of policy outcomes lies primarily with factors intrinsic to different policy domains, rather than general conditions relating to governance.

## Direct Measure of Inputs

Measuring all the inputs relevant to governing is impossible, but for some government programs inputs may be relatively straightforward to assess. Spending on unemployment benefits are clearly related to actual unemployment levels, for example. Likewise, Social Security payments are based on a formula that rests on changing age demographics, while spending on disaster relief and insurance is closely linked to the occurrence of weather related calamities. This section revisits Figures 1.4 and 1.5 from Chapter 1 - which looked at population demographics and hurricane damages – and considers data on unemployment insurance in order to give a brief history of the inputs relevant to these different government programs. The purpose is to illustrate how the natural complexity associated with different policy domains interacts with political complexity as a powerful driver of the instability observed in government budgets.

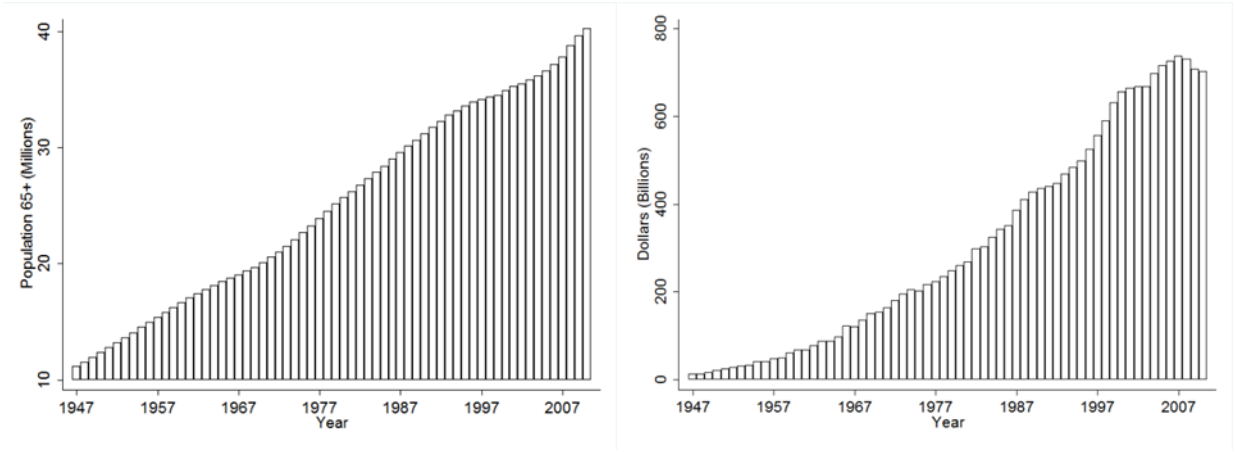
The Social Security Act of 1935 was a broad response to the Great Depression, designed to guarantee a minimum standard of living to the nation's elderly by providing old-age benefits payable upon reaching the age of 65. However, in 1939 the law was expanded to provide benefits to the widows and children of workers who died prematurely, in 1956 the law came to include benefits to disabled workers over the age of 50, and in 1972 Social Security added the supplemental income program and underwent its first cost of living adjustment. So while the initial indicator relevant to Social Security payments was age demographics, this narrow scope was quickly expanded. Still, the centerpiece of the law remains payments to persons over the age of 65.

Age demographics are comparatively simple, changing by only small annual margins. The left panel of Figure 2.3 shows the number of people in the US over the age of 65 from 1947 through 2010, measured in millions of people. The slope of the increase is almost straight, indicating that the annual rate of change is fairly constant. If government spending on Social Security was tied directly to this population, as the original law provided, then government outlays to Social Security should match the rate of change observed in the population. This appears to be the case, as the right panel of Figure 2.3 makes clear. The figure shows outlays in billions of dollars by the Federal government toward Social Security and for the most part, government outlays match changes in the population; both steadily increase over time. The correlation between spending and population growth is 0.98.

Note however, that changes in spending are not quite as smooth or gradual as the population trend. With Social Security, the government implemented a program with a clear indicator in mind – the elderly population – but policymakers quickly reconsidered the scope of their focus. By expanding the population targeted for Social Security payments and the size of the payments themselves, the government was soon diverted from stable demographics to considering a more diverse array of indicators. Of course, if we knew the appropriate indicator to relate to each government program, then we would have solved the complexity problem that causes governments to over- and under-respond to issues in the first place. Uncertainly about the appropriate indicator for any government program, can crate instability even in seemingly straightforward programs like Social Security. Overall, however, spending on Social Security shows little evidence of large-scale disequilibria.

Figure 2.3. Comparing Age Demographics and Federal Outlays on Social Security

a) US Population Aged 65 and Over b) Social Security Outlays




Note: Correlation between spending and population = 0.98

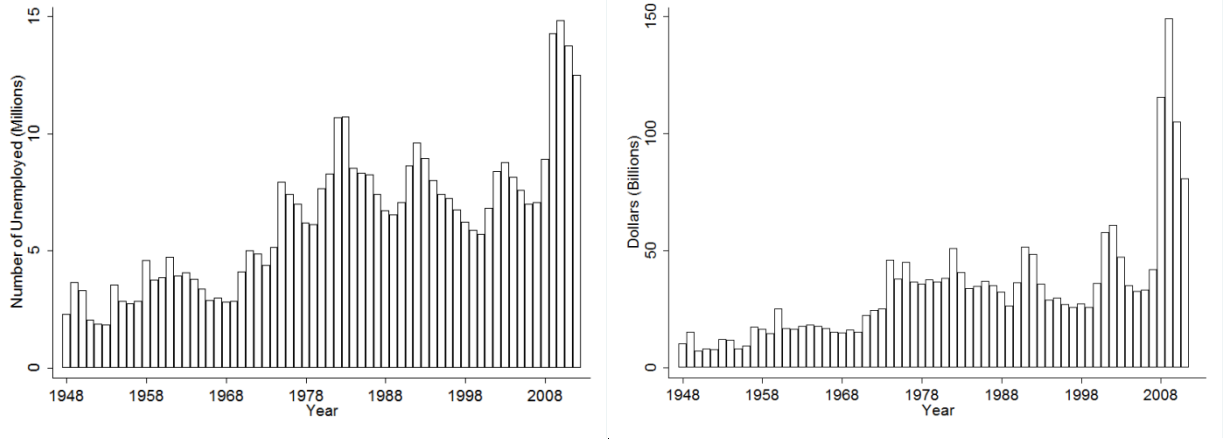
Unemployment insurance is another government program where the relevant indicator would seem relatively straightforward to assess. Like Social Security, the unemployment insurance system was enacted in response to the Great Depression. In fact, it was the same Social Security Act signed by President Roosevelt in 1935 that contained provisions directing the states to develop unemployment laws in partnership with the federal government. Unlike Social Security, however, unemployment insurance is not based on stable age demographics. Rather, the number of unemployed follows the economic business cycle, which has less predictable dynamics.

Figure 2.4 compares the number of unemployed (in the left-panel) to federal outlays on unemployment (on the right). As with Figure 2.3, the correlation between the two panels is high: 0.83. But in this case, government outlays show much greater instability, as would be expected for a program that is based on an indicator that is itself highly volatile. Unemployment insurance is also more contentious than Social Security; debates about eligibility and the duration and size of benefits have surrounded the program since its inception. Political disagreements have led to frequent upheaval in the laws governing unemployment benefits, which may contribute to the

volatility on display in the right-panel. Further, we can expect policymakers to under or over-react to unemployment levels, so spending adjustments are not necessarily proportional to changes in the unemployment rate. Still, the high correlation indicates that spending tracks unemployment quite closely, so we can surmise that variability in economic fundamentals is a powerful source of the instability in spending.

Figure 2.4. Comparing Unemployment and Federal Outlays on Unemployment Compensation

a) The Number of Unemployed b) Unemployment Outlays




Note: Correlation between spending and unemployment = 0.83

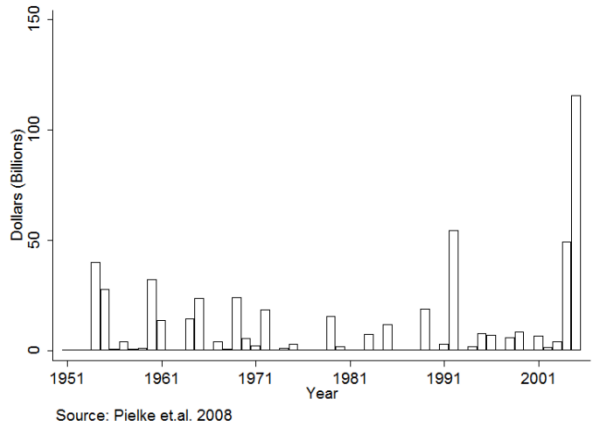
Finally, I look at spending on disaster relief and insurance – an area of budgeting where the relevant indicators are extremely difficult to predict. Until the early 1900s, the federal government responded to natural disasters by passing case-specific legislation. In the 1930s various agencies were tasked with responding to different categories of disaster, but it was not until 1979 that these efforts were consolidated into the modern Federal Emergency Management Agency (FEMA). Outlays to this program are highly contingent on the occurrence of natural disasters, such as hurricanes, tornados, earthquakes, or droughts. Unlike age demographics or even unemployment rates, however, the frequency and intensity of natural disasters defy easy prediction. The left panel of Figure 2.5 illustrates this by showing normalized hurricane damages in the US from 1900 through 2005. While age demographics showed a clear, steadily increasing

trend and unemployment levels appeared cyclical, there is no apparent trend with hurricane damages. Instead, the size of the damage fluctuates widely from year to year.

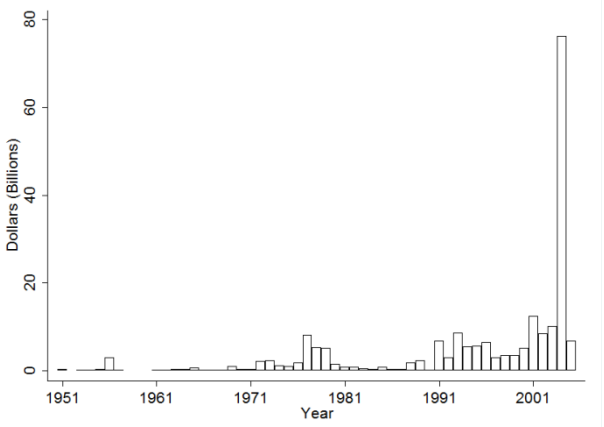
Based on the left-panel of Figure 2.5, we can expect any program where spending is tied to the scale of natural disasters to undergo frequent punctuations. The right-panel of Figure 2.4, which shows annual inflation-adjusted outlays for disaster relief and insurance, confirms this expectation. Spending on disaster relief is highly erratic and, further, does not come close to matching the pattern of hurricane damages. In part, this discrepancy can be attributed to the fact that disaster relief includes many categories of natural disaster besides just hurricanes, but we can also expect the government to respond inefficiently to certain natural disasters; overspending in some cases and underspending in others. The larger point is that budget categories that are linked to stochastic input series show high levels of volatility, while those linked to more stable inputs show much less.

Figure 2.5. Comparing Hurricane Damages and Federal Outlays to Disaster Relief

a) Hurricane Damages




b) Outlays to Disaster Relief and Insurance




**N**ote: Correlation between spending and hurricane damages = 0.30

Table 2.1 shows that spending on disaster relief and insurance underwent 43 punctuations from 1947 to 2012. During the same period, spending on unemployment compensation saw 21 punctuations and Social Security had only 1. Figures 2.3 through 2.5 go a long way toward

explaining the disparity. Age demographics change incrementally and predictably from year to year, unemployment levels follow the economic business cycle, but hurricane damages fluctuate wildly. By linking spending programs to these very different sets of indicators, policymakers ensure that the budget will undergo both incremental and extreme changes. However, the stability of indicators is not the whole story. Often there is uncertainty as to what indicators are the most appropriate measures to inform public policy and this was reflected in that fact that outlays for Social Security and unemployment insurance did not perfectly match either age demographics or unemployment levels.

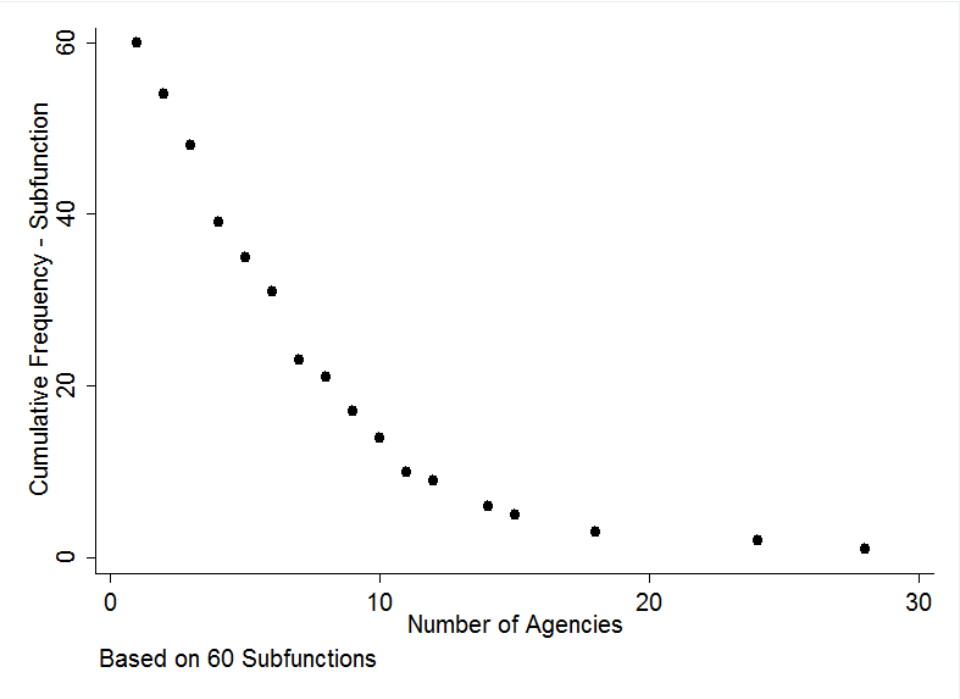
## Predicting Punctuations

The preceding analysis offers clues as to what factors are related to policy instability. Can we put it all together and predict the occurrence of a punctuation in budgetary time series? Successfully predicting punctuations has largely eluded the agenda-setting literature, for the most part because the occurrence of punctuations is thought to be predominantly stochastic, making the specification of statistical models challenging. Undaunted, the chapter estimates a series of logistic regressions.

A key independent variable is the complexity associated with each budget category and the expectation is that instabilities will increase with complexity. To operationalize complexity, I use a dataset available from the Bureau of Economic Analysis (BEA), which links spending allocations to the government agencies in charge of implementing them. For example, the National Science Foundation is frequently authorized to spend money allocated to the budget category for "general science and basic research." The BEA data is available from 1976 through 2008 and during this period some categories, such as Social Security, have fallen exclusively under the purview of a single agency, while others are carried out by upward of 20. The measure

of complexity simply counts the number of unique agencies that have been linked to each subfunction. Figure 2.6 shows the cumulative frequencies of agencies to subfunctions. All 60 subfunctions that appear in the BEA data are associated with at least one agency; about 15 are linked to more than 10 agencies, and only 2 are associated with more than 20. The measure is a simple but effective operationalization because complexity should be especially acute where multiple agencies are involved as there will be more room for disagreement over the varying "solutions" that different agencies have to offer.

Figure 2.6. The Number of Agencies by Subfunction




Beyond complexity, the regressions include dichotomous variables for a honeymoon period and unified government, coded 1 if the reallocations were from the first budget of a new president or took place during unified government. The regressions also account for congressional polarization, which might similarly affect the possibility for major policy shifts. When polarization is low, there is more room for cooperation between parties, but during periods of high polarization, even basic responsibilities such as funding the government can be

sidetracked. To operationalize polarization the regressions includes a measure of House polarization adopted from Keith Poole and Howard Rosenthal's DW-Nominate scores. From 1947 through 2012 the measure varies between 0.40 and 1.10, with lower values indicating less polarization. Finally, the regressions control for the amount of money allocated to each subfunction in each year. A plausible concern would be that punctuations are more likely for small budget categories, as it is comparatively easy to make a large change to a small base value. Table 2.4 shows the results of the first model, predicting the occurrence of a punctuation in either the positive or negative direction.[3]

Table 2.4. Logistic Regression Predicting the Occurrence of Budget Punctuations

| Variable | Odds Ratio | Standard Error |
|---|---|---|
| Lagged Punctuation | 6.02* | 0.57 |
| Dollars | 0.99* | 0.00 |
| Unified Government | 1.08 | 0.10 |
| House Polarization | 0.54* | 0.13 |
| Honeymoon Period | 1.12 | 0.13 |
| Subfunction Complexity | 1.03* | 0.00 |

N = 3,405
Pseudo $R^2$ = 0.126
* = significant at 0.05 p-value

The odds-ratios for all 6 variables are in the expected direction and 4 are statistically significant. Clearly dramatic changes cluster together in budgetary time series; a punctuation is 600% more likely if one occurred the previous year. Punctuations are less likely as budget categories increase in size, but as the dollar variable is coded in thousands, the effect is only very modest. As expected polarization is a strong predictor of policy instability. Moving from very low to very high polarization decreases the likelihood of a major policy shift by about 50%. We also see a strong, and highly significant, effect for subfunction complexity. Each additional

[3] The appendix to the chapter estimates a cross-sectional time-series model with random effects, treating each budget category as the panel unit. In this specification, the dependent variable is the absolute value of percent change in spending. Results are robust across model specifications.

agency increases the chance for a punctuation by 3% and this variable ranges from 1 to 27, so moving from the least to the most complex budget category has a major effect. The odds-ratio for unified government and the first budget of a new president are above 1, as expect, but not significant. These effects may simply be drowned out when controlling for other factors. We can imagine, for instance, that the ability of presidents to inflect a budget with their own priorities will be highly contingent on polarization, regardless of any benefits incurred through a honeymoon period.

Table 2.4 provides an overview that supports the chapter's theoretical underpinnings; chief among them that complexity powerfully conditions the stability of policy outcomes. But there is no reason to expect that policymaking works the same way in both directions - the dynamics of large increases in spending may be very different from those that determine when a major spending cut will take place. To address this possibility I estimate a multinomial logit model, with categories for positive and negative punctuation. Table 2.5 shows the results.

Table 2.5. Logistic Regression Predicting the Occurrence of Positive and Negative Punctuations

| Variable | Odds Ratio | Standard Error |
|---|---|---|
| **Positive Punctuation** | | |
| Lagged Punctuation | 0.91* | 0.07 |
| Dollars | -0.00 | 0.00 |
| Unified Government | -0.01 | 0.12 |
| House Polarization | -1.07* | 0.32 |
| Honeymoon Period | -0.09 | 0.16 |
| Subfunction Complexity | 0.03* | 0.00 |
| Constant | -2.00* | 0.23 |
| **Negative Punctuation** | | |
| Lagged Punctuation | 0.91* | 0.07 |
| Dollars | -0.00* | 0.00 |
| Unified Government | 0.29* | 0.12 |
| House Polarization | -0.42 | 0.30 |
| Honeymoon Period | 0.31* | 0.14 |
| Subfunction Complexity | 0.03* | 0.00 |
| Constant | -2.51* | 0.23 |

N = 3,417
Pseudo $R^2$ = 0.077
* = significant at 0.05 p-value

Based on the large and statistically significant odds-ratio for lagged punctuations we can conclude that dramatic increases (or decreases) in spending often play out over multiple years. Note that the effect of congressional polarization and subfunction complexity are similar to what was seen with the full model in Table 2.4. The odds-ratio for dollars is no longer significant, suggesting that the size of budget categories does not alter their likelihood of seeing major increases in spending.

The model is equally successful at predicting negative punctuations. But, for the first time, polarization does not have a statistically significant effect on the likelihood of a punctuation occurring. It seems that punctuations of any type are less likely when polarization is high, which is consistent with the idea that political gridlock is a corollary of polarization. Another change from the previous regressions is that the presidential honeymoon period now positively predicts the occurrence of large spending cuts. This suggests that presidents are more inclined during

their first year in office to reverse the policies of their predecessors than to embark on their own initiatives. Subfunction complexity is again a strong predictor of major spending changes. This matches theoretical expectations; agencies assigned to the same budget function experience fiscal windfalls and hardships together.

## Discussion

Previous research focuses generally on cognitive and institutional limitations as the primary cause of punctuations in outputs from various organizational decision-making processes. The goal in this chapter has been to unpack the black box these limitations have come to represent and encourage a discussion of the factors that may explain variation in the degree of punctuations seen in various political outcomes. The advantage of this approach is that it directly measures relevant inputs, considering how variance in the stability of different input series can help explain the occurrence of punctuations. Budget categories which are tied to unstable inputs are much more likely to experience spending punctuations than are those categories linked to more stable input series. The other powerful predictor of punctuations was political complexity, which was operationalized in the model using the subfunction-complexity score. But governing conditions, including presidential term year and majority party control of government, apparently have little effect on the occurrence of punctuations. The exception to this was polarization, which greatly reduced the likelihood of punctuations in any direction.

Given these findings, we can reasonably expect that even a government operating without cognitive or institutional frictions would occasionally produce spending punctuations, so long as it was responsive to changing stochastic events. By tying large portions of the budgets to demographic changes, policymakers ensure that many spending reallocations will be automatic and incremental. So, in summary, while it is logical to assume that aggregate inputs will be

normally distributed, and while a perfectly attentive government may produce normally distributed outlays to match, actual governments are highly sensitive to specific inputs that are on a case-by-case basis unstable. This seems especially relevant considering that the link between efficiency and punctuated change distributions is usually drawn such that greater instability is indicative of less efficiency. It is true that if governments had access to perfect models of the natural world, explanations for spending instabilities would rest heavily on shifting political considerations. An altogether different question is how efficient are governments at processing the information they have available. From this perspective, reactive punctuations take on a new significance. The U.S. government does not know when a powerful hurricane will hit the Gulf Coast, but at least it can respond to the disaster when it happens. Given current levels of information, a change distribution without any punctuations is more sinister than one with high kurtosis.

## CHAPTER THREE: HOW ROBUST ARE DISTRIBUTIONAL FINDINGS OF PUNCTUATED EQUILIBRIUM IN PUBLIC BUDGETS?

A curious finding from Chapter 2 was that many spending punctuations appear to be immediately followed by a dramatic change in the opposite direction. Negative punctuations were 900% more likely after a positive punctuation and positive punctuations 400% more likely after major spending cuts. This suggests that punctuations are often fleeting, with policymakers moving to reverse major shifts in spending after only one year. This temporary dynamic is hard to reconcile with punctuation equilibrium theory, which emphasizes competition between policy solutions as a key driver of political instability. The logic of this idea is that the negative feedback forces that generate the equilibrium can occasionally be disrupted, creating a surge of self-reinforcing changes that rapidly achieve a new equilibrium. But if punctuations see major reversals after only one year, then it would be difficult to claim that some new equilibrium has been reached. That is, far from paradigm-shifts punctuations may indicate brief governmental interventions to address temporary and stochastic problems.

At issue, is the distributional approach to policy studies, which pools observations across multiple years and issue domains. (I took this approach in Chapter 2 and the section on empirical methods from Chapter 1 describes the methodology.) Given the findings from Chapter 2, a concern is that different processes could be generating the cases in the central peak of the distribution and those far out in the tails. The normal interpretation has been that a single theory can account both the periods of stability and massive change. The cases in the tails represent punctuations – dramatic shifts in policy direction, or at least massive changes in budgetary

commitments to certain ideas – and the high central peak is caused by inattention to the majority of problems.

Concerns about what causes punctuations can be largely avoided using a historical, case-study approach, and indeed, this is the methodology that was employed by Baumgartner and Jones when developing their theory (1993). It continues to be an important tool in policy studies, but the distributional approach has gained widespread popularity because it offers both a comprehensive perspective and facilitates international comparisons. There is in this case a tradeoff between generalizability and precision. In this chapter I ask if the tails and central peaks of budget distributions could be generated by factors inconsistent with the theory of punctuated equilibrium. I begin by exploring how often and how quickly punctuations see reversals and then assess the robustness of fat-tailed distributions controlling for relevant factors.

## Background

My approach is informed by previous research that explores the nature of policy punctuations. In particular, I look to a study by Peter John and Shuan Bevan (2011) that develops a three-tiered typology for punctuations in the U.K. context as an intellectual precursor to the current analysis. They group punctuations according to three causal processes: procedural adjustments, low-salience, and high-salience adjustments. Their argument is that punctuations resulting from procedural reclassifications are a-theoretical and in some cases should be removed from the data. Further, they point out that it is difficult to reconcile punctuations occurring in the absence of any attention to the casual process identified by punctuation equilibrium theory. Their question then is how many of the punctuations they observe can be linked to shifts in attention, rather than the competing mechanisms. They discover that a substantial proportion—about half—of the punctuations they identify occurred either as part of a procedural adjustment or with

an almost complete lack of public attention. I engage in a similar process here, identifying mechanisms in the data generating process that could potentially produce cases in the tails of a distributional analysis which would not correspond to the data generating process implied in the punctuated equilibrium model.

## Identifying Punctuations

I start by returning to a classic example of a punctuation—coverage of pesticides, as originally documented by Baumgartner and Jones (1993). They describe how from their development around the turn of the 20th century until the late 1950s pesticides were viewed as a marvel of modern technology, a panacea that would usher in a new age of agricultural productivity and public health. Given the positive press surrounding pesticides it seemed logical for the U.S. government to support their liberal application, and indeed large swaths of the continental U.S. and other parts of the world were blanketed in DDT. Then, in the mid-1950s, it began to dawn on people that while very effective at killing insects, pesticides do not discriminate; they kill many other things as well. This idea culminated with the publication of *Silent Spring* in 1962 by Rachel Carson, which documented the disastrous environmental consequences of indiscriminate pesticide use.

Figure 3.1, which is borrowed from Baumgartner and Jones (1993), clearly shows the dramatic reversal of fortunes pesticides saw in the 1950s. The turning point appears to be 1957. Before this year, articles on pesticides had been remarkably supportive—in many years every single article on the topic had a positive tone. After 1957, the majority of articles cast a negative light on pesticides. I have updated the original figure after conducting difference of means tests using 1957 as the dividing point in the data. The dashed horizontal lines show the mean value of

support before and after 1957. As the subtext to the figure notes, before 1957 this value was 93% and after it was 29%, representing a major shift in the debate over pesticides.

Figure 3.1. The Classic Punctuation: Media Coverage of Pesticides


Before: 93.1, After: 29.1; T-test of difference, chi-sq = 32.39, df = 87, prob. < .0000.
Source: Baumgartner and Jones 1993, Figure 5.3.

The dynamic on display in Figure 3.1 exemplifies what is typically thought of as a punctuation in the literature on agenda setting. This is the idea that disequilibria in policy series herald a paradigm shift, where some new approach or solution takes precedent and traditional ways of doing things are rapidly discarded. In the case of pesticides, this shift came when people stopped viewing pesticides as an easy solution to various societal problems and started seeing them as harmful carcinogens. With this type of punctuation we should be able to look at a policy series and draw a clear line denoting the point where perceptions flipped and a new paradigm took hold.

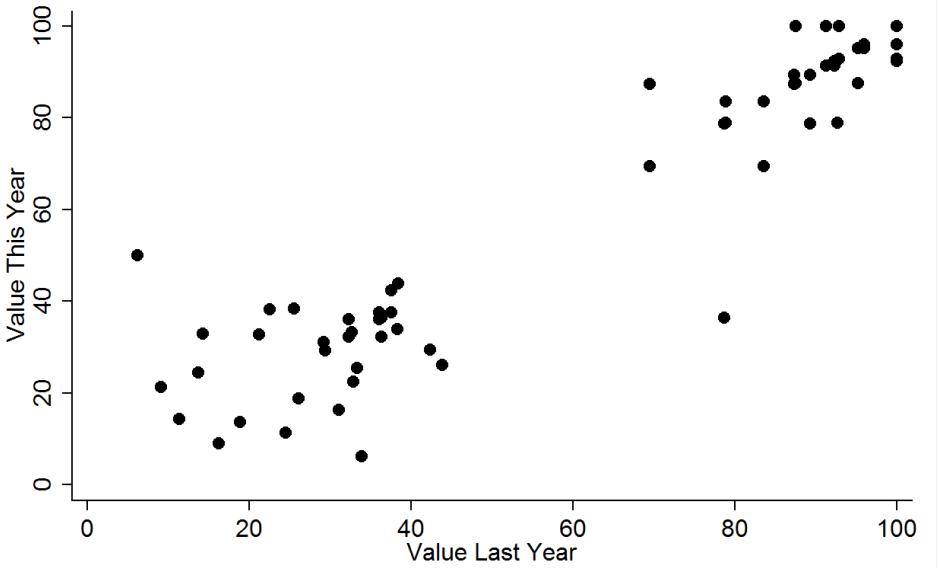
But moving to a distributional approach allows the possibility that many of the punctuations we observe are 'false' or temporary, in the sense that they are quickly reversed and signify very little about political agendas. How then do we distinguish between 'real'

punctuations, the focus of agenda-setting theories, and temporary punctuations? This is the central question of the chapter, and I employ various empirical strategies to answer it.

One straightforward approach is to test for serial auto-correlation, with the expectation that volatile policy series where punctuations are quickly reversed will show low correlations between current and previous values. In Figure 3.1, it is clear that during the early period, values remain consistently high; only in 1957 does the value dramatically shift from the previous value, and remain distinct in its future values from the past ones. Seen in this way, inertia is a key element of the theory. Most issues, most of the time, maintain a certain 'stickiness,' maintained in equilibrium by negative feedback. Serial auto-correlation is a simple way to look at this; series with high inertia should have high correlations between any given value and the previous one. Series with high variability around a central value that itself does not change, do not correspond with the theory, and they would show low values of serial auto-correlation.

Figure 3.2 illustrates the expected relationship by plotting the percent positive media coverage about pesticides against their lagged values (the data are the same as from Figure 3.1). Here auto-correlation is very high and we see that the data is divided into two groups; high values (stemming from the period before the punctuation in 1957) and consistently low values (coming after the 1957 collapse in the public image of the industry). So, with the one major exception, last year's values are a strong predictor of current year values. As series become more volatile, and punctuations more temporary, we can expect this relationship to break down.

Figure 3.2. Serial Auto-correlation in Coverage of Pesticides, 1900 to 1988.




Data are percent positive media coverage of pesticides plotted against their lagged value. Correlation = 0.95. Source: Derived from Baumgartner and Jones 1993, Figure 5.3.

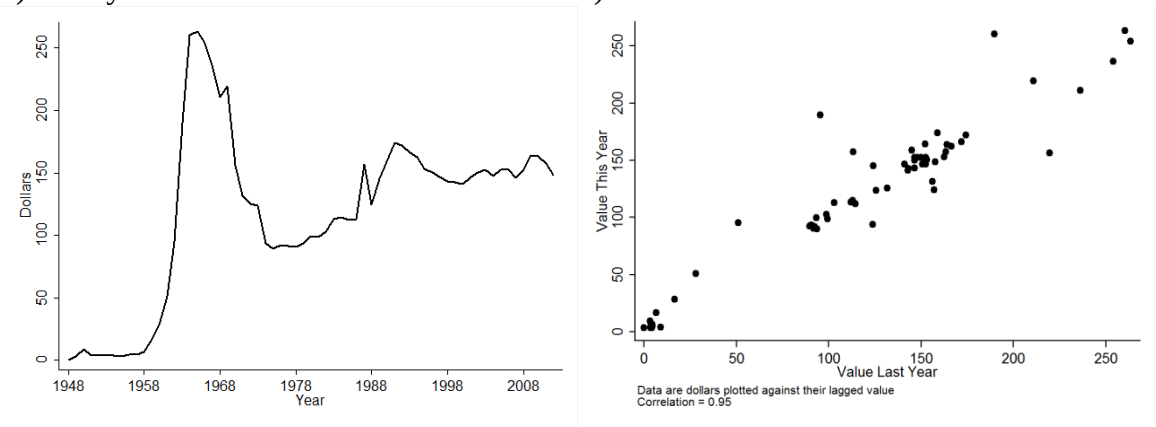
I turn now to spending by the U.S. federal government from 1947 to 2012 in order to systematically document the occurrence of temporary versus sustained punctuations, but I begin with simple descriptive examples. Remember that the pesticides example represents the classic but also ideal case of a sustained punctuation, so one question is how closely any budgetary series will come to replicating that pattern of change.

Figure 3.3 shows outlays toward "space flight, research, and supporting activities", one of the 66 non-financial budget categories (called subfunctions in OMB parlance) that make up the U.S. budget. The left-panel, tracking outlays in millions of dollars, reveals some dramatic changes in spending. Most notable is the enormous increase that took place in the early-1960s corresponding to the Apollo moon missions. But these high levels of spending were not sustained and after successfully landing a person on the moon the government substantially scaled back spending to this category. Still, spending never returns to its pre-Apollo levels and space flight is certainly a higher priority in the modern era than it was before 1958. So while the

major punctuation in this series is not sustained to the same degree as what we saw when looking at pesticides, this is a clear example of 'real', substantively interesting punctuation. The right panel of Figure 3.3 looks at the serial auto-correlation of spending on space flight, revealing a pattern that is familiar from the pesticides example. Current spending levels are correlated with the previous year's spending at 0.95 and again we see gaps in the coverage corresponding to the occurrence of a punctuation.

Figure 3.3. U.S. Spending on Space Flight, Research, and Supporting Activities, 1948 to 2012

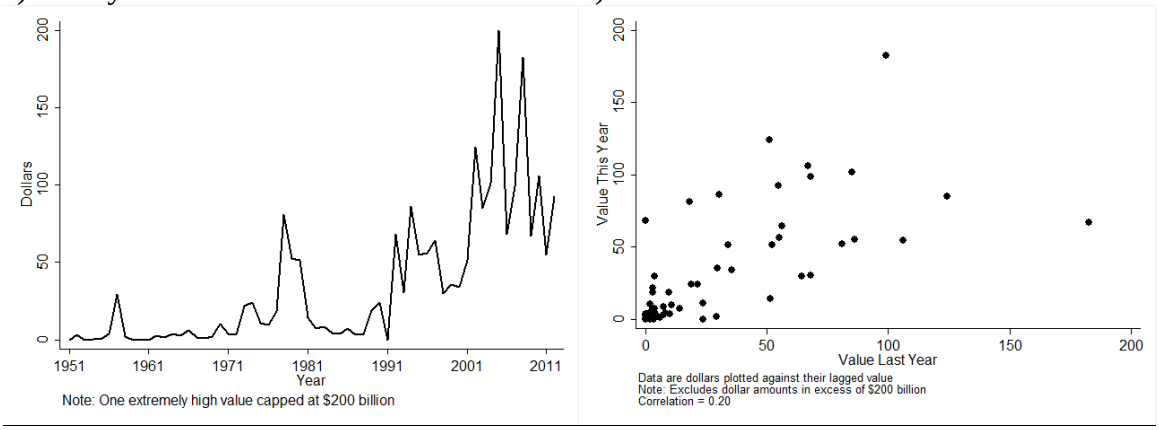
a) Outlays b) Serial Auto-correlation




For an example of a temporary or 'false' punctuation consider Figure 3.4, which tracks outlays toward "disaster relief and insurance". Again the left-panel of the figure shows annual outlays, where, unlike with spending on space flight, it is difficult to see trends indicative of a larger political agenda beyond the basic need for responsible governments to respond to crises as they occur. The right-panel of Figure 3.4 supports the assertion that measuring serial auto-correlation can be a useful tool to distinguish between series that are prone to temporary versus sustained punctuations. Here we see that current values are only correlated at 0.20 with the previous year's spending; exactly what we would expect from a series that is heavily driven by exogenous shocks.

Figure 3.4. U.S. Outlays toward Disaster Relief and Insurance, 1951 to 2012

a) Outlays b) Serial Auto-correlation

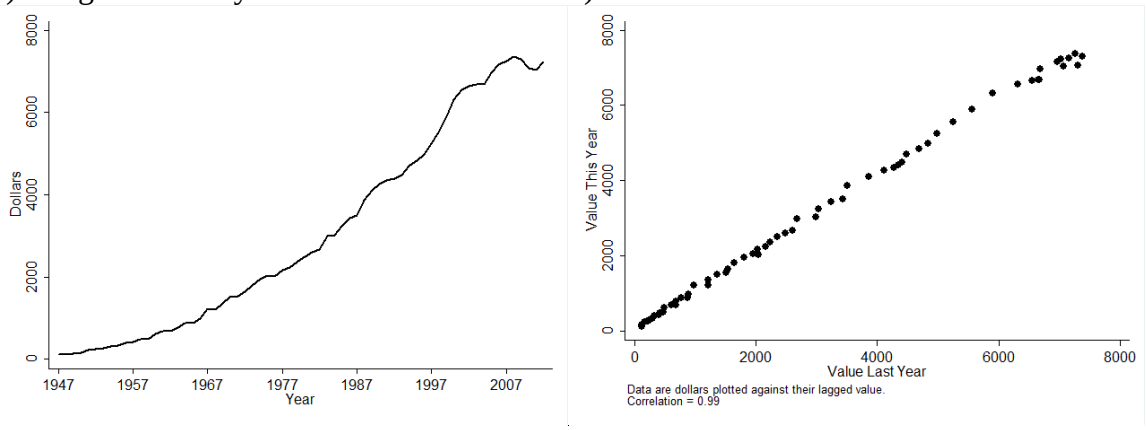



Figures 3.3 and 3.4 both look at discretionary spending topics, but the U.S. budget is increasingly devoted to spending on mandatory programs, where spending levels are determined by well-established formulas that are politically difficult to adjust. A substantial part of the budget is therefore largely insulated from the type of agenda setting thought to cause policy punctuations. Further, spending for many of the mandatory categories is often strongly driven by demographic trends, such as retirements, and should logically have dynamics distinct from those domains that are subject to endogenous or exogenous shocks. We cannot state that any particular budget category is driven by a purely demographic logic; even in the case of retirements and pensions, important shifts sometimes occur in the formulae used to determine entitlements. But some budget categories are clearly much more prone to instabilities than others.

Figure 3.5 considers Social Security, revealing the particular dynamics that appear to govern mandatory spending relating to demographic shifts. While spending on space flight was subject to the whims of political enthusiasm, and in the case of disaster relief the extreme variability of the physical climate, spending on Social Security climbs relentlessly upward regardless of party control of government or historical circumstances. Note that the correlation in the right-panel is at 0.99, emphasizing that there are almost never large shifts in spending.

Figure 3.5. U.S. Budget Authority toward Social Security, 1947 to 2012

a) Budget Authority b) Serial auto-correlation



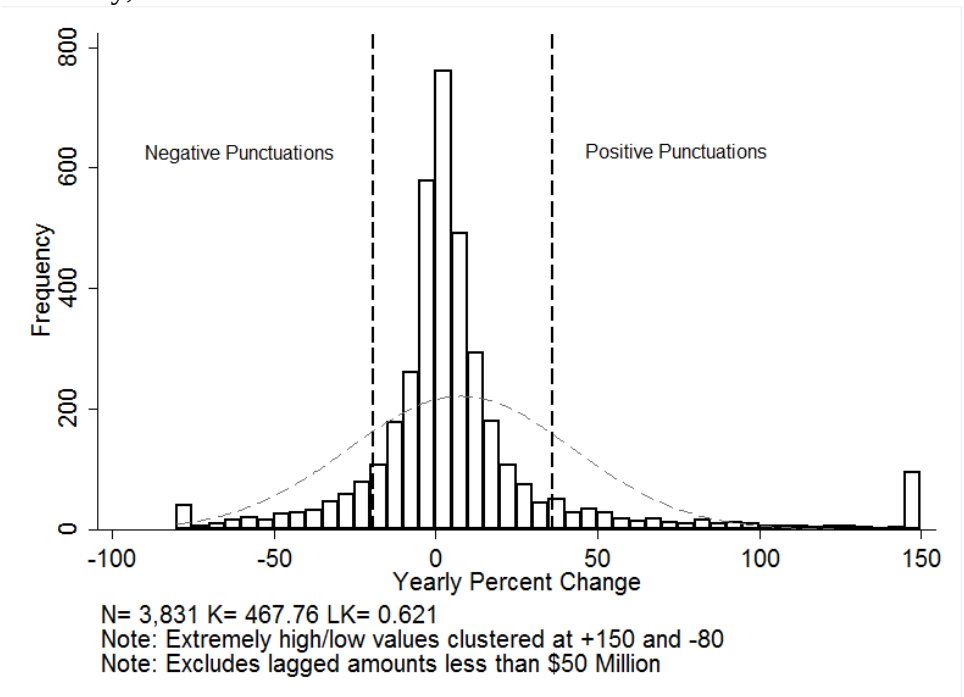

The type of change exemplified by spending on space flight, where shifting political ideals determined spending levels, is the best match to the causal process commonly identified in the literature on punctuations. But as this brief review demonstrates, it is far from the only dynamic at work. A fuller understanding of the causes of policy change must take seriously the possibility that policymakers have tied their hands by placing a majority of the budget under automatic spending formulas. While this does not eliminate political agendas as a causal factor—formulas are sometimes updated—it does suggest that much of the budget will not be particularly susceptible to agenda setting dynamics as laid out in the theoretical literature. A larger concern would be that much of the instability usually attributed to the rise and fall of issue frames is actually rooted in a much simpler and politically mundane phenomenon—the need for governments to respond to various military and natural crises. When a crisis occurs spending is dramatically ramped up in response, but as soon as the emergency dissipates, spending is brought back down to pre-crisis levels. In these circumstances, punctuations in the positive direction would beget major decreases in spending within a few years; we would observe instabilities coming and going. This tidal process could be a powerful source of the instability observed in government budgets, but would have little connection to traditional conceptions of agenda setting.

Given the various concerns and competing causal processes my goals are twofold. First, I make a systematic effort to document the relative frequencies with which temporary and sustained punctuations occur in budgetary time series. Then, informed by that effort, I test the robustness of previous findings after excluding categories prone to temporary punctuations and mandatory spending.

## Measuring Sustained Punctuations in the U.S. Budget

The focus is on U.S. budget authority from 1947 to 2012 and Figure 3.6 reintroduces the budget distribution from Chapter 2. Once again, a punctuation is defined at the top and bottom ten percent of the observed changes, for a total of 783 punctuations.

Figure 3.6. Identifying Punctuations in the Distribution of Annual Changes in Federal Budget Authority, 1947 to 2012




Many studies have sought to explain the causes of punctuations, but for the most part these investigations have rested on broad theoretical arguments about the disproportionately of government information processing. Few attempts have been made to 'drill down' into the data in order to determine how many of the punctuations we observe can be attributed to shifting

political agendas versus high volatility in input series that force a government response. Both factors are clearly at work, as the examples looking at outlays toward space flight and disaster relief demonstrated. So the question is simply: how many of the punctuations defined Figure 3.6 are temporary versus sustained?

Of course, 'temporary' and 'sustained' are subjective terms, so there are many ways to go about answering the question. Table 3.1 provides 20 possible answers. It documents the number of punctuations that are reversed by a certain percent over a certain number of years. Reading the first row of the table from left to right reveals that 376 punctuations, or 49% percent of the total, were reversed by at least 10% after only 1 year, 394 were reversed by at least 10% after 2 years, and so on. What does it mean to say that a punctuation was reversed by at least 10%? Consider a punctuation that increased spending to a budget category by 75% over its base value of $100 (so for the year the punctuation took place spending is now at $175). If in the year following that punctuation spending then decreased by at least $7.5 (10% of the $75 increase), we can say that punctuation was reversed by 10% in 1 year.[4]

[4] I calculate reversals separately for positive and negative punctuations. In the case of a negative punctuation, a 75% decrease to a base value of $100 leaves $25. I consider that punctuation reversed by 10% within 1 year, if in the next year spending was increased by at least $7.5.

Table 3.1. How many Punctuations see Reversals between 10 and 90% within 4 years?

| Reversal | 1 Year | 2 Year | 3 Years | 4 Years |
|---|---|---|---|---|
| 10% + | 376 (49%) | 394 (52%) | 400 (54%) | 383 (52%) |
| 25% + | 309 (40%) | 332 (44%) | 342 (46%) | 342 (47%) |
| 50% + | 217 (28%) | 255 (34%) | 278 (38%) | 279 (38%) |
| 75% + | 160 (21%) | 199 (26%) | 224 (30%) | 230 (32%) |
| 90% + | 128 (17%) | 164 (22%) | 189 (26%) | 201 (28%) |

Note: Year 1 Punctuations = 766; Year 2 = 754; Year 3 = 740; Year 4 = 726

Table 3.1 shows the number of punctuations that saw reversals according to different terms, leaving the remaining punctuations to qualify as sustained[5]. That is, if 49% of punctuations were reversed, then the remaining 51% can be thought of as sustained. In this way, the table presents definition of varying strictness for what constitutes a sustained punctuation. The upper-right cells in the table show definitions that are very strict; here any punctuation that is reversed by 10% over the course of 3 or 4 years is considered temporary. Using this definition would place the majority of the punctuations documented in Figure 3.6 in the temporary category. The lower-left cell shows the least restrictive definition, where only punctuations that are reversed by more than 90% within 1 year qualify as temporary. Depending on which cell in the table we occupy makes a big difference as to our conclusions regarding the relative frequencies of these punctuations. Regardless of definition, temporary punctuations make up a substantial proportion of the instabilities documented in Figure 3.6; somewhere between 17% and 54%.

Figure 3.7 provides a hypothetical example of a punctuation that has decayed by 10% within 4 years (the definition from the upper-right cell in the table). The idea here is to give a visual sense for this type of change. The figure shows two huge increases in spending, which within 4 years have been reversed by exactly 10%, with the vertical lines showing the 4-year

[5] Note that the total number of punctuations diminishes slightly when calculating changes multiple years in the future because observations are lost from years 2009 through 2012.

window. If we accept the upper-right cell as our definition of a sustained punctuation, then the changes Figure 3.7 displays would not qualify. This clarifies just how restrictive this definition is, and it should come as no surprise that under this definition fewer than half the total punctuations are considered sustained.

Figure 3.7. Hypothetical Budget Series with Punctuations that are Reversed by 10% in 4 years

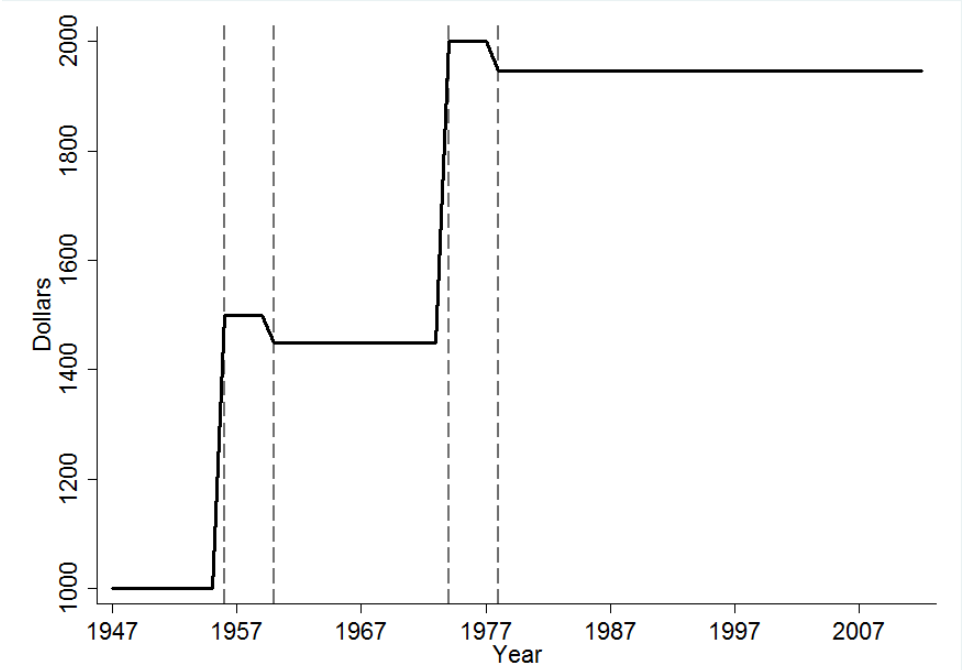
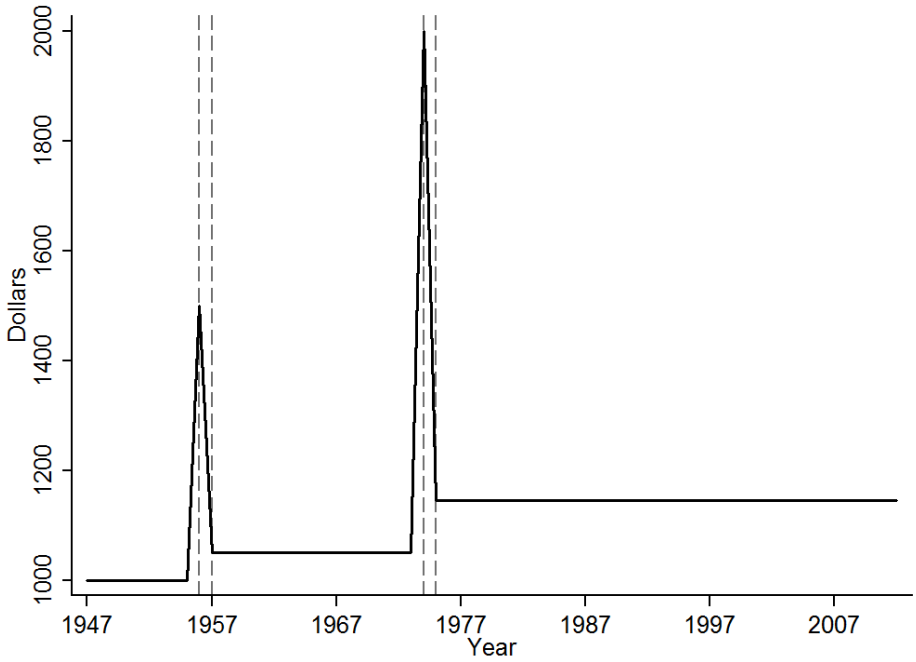



Figure 3.8 provides a similar hypothetical this time for the cell in the lower-left of the table—punctuations that are reversed by 90% within 1 year. Clearly this is an altogether more dramatic reversal, where within 1 year the original punctuation is almost completely eliminated.

Figure 3.8. Hypothetical Budget Series with Punctuations that are Reversed by 90% in 1 year




I have tried to show that the number of punctuations that can be considered sustained depends heavily on the parameters involved, but in order to proceed to subsequent analysis I must pick a definition. I define sustained punctuations as those that do not see reversals upward of 50% within 4 years (the middle cell in the right-most column of Table 1). The logic behind this choice is that the process by which new issue frames supplement old ones is thought to play out over many years or decades, so we can reasonably expect punctuations that are brought about by shifting political agendas to last at least 4 years. I pick the 50% reversal rate simply as a conservative, middle-of-the-road option. Based on this definition, 279 punctuations are classified as temporary and 447 as sustained. Table 3.2 shows how these punctuations are distributed by OMB subfunction, and the right-most column shows the serial auto-correlation of each budget series.

Table 3.2. Total Punctuations and Punctuations Sustained by at least 50% over 4 Years, by OMB Subfunction

| OMB Subfunction | Total | Sustained | Temporary | Auto-Corr. |
|---|---|---|---|---|
| Disaster Relief and Insurance | 37 | 20 | 17 | 0.21 |
| Military—Other | 28 | 14 | 14 | 0.23 |
| Farm Income Stabilization | 31 | 18 | 13 | 0.60 |
| Area and Regional Development | 23 | 12 | 11 | 0.52 |
| Community Development | 21 | 10 | 11 | 0.99 |
| General Property and Records Management | 28 | 17 | 11 | 0.48 |
| Other Advancement of Commerce | 28 | 17 | 11 | 0.43 |
| Higher Education | 22 | 12 | 10 | 0.81 |
| Unemployment Compensation | 20 | 10 | 10 | 0.85 |
| Defense-related Activities | 23 | 14 | 9 | 0.45 |
| International Development and Humanitarian Assistance | 23 | 14 | 9 | 0.74 |
| International Security Assistance | 27 | 18 | 9 | 0.79 |
| Housing Assistance | 21 | 13 | 8 | 0.65 |
| Training and Employment | 20 | 12 | 8 | 0.69 |
| Veterans Education, Training, and Rehabilitation | 27 | 19 | 8 | 0.92 |
| Other Income Security | 7 | 0 | 7 | 0.99 |
| Research and General Education Aids | 15 | 8 | 7 | 0.93 |
| Executive Direction and Management | 12 | 6 | 6 | 0.93 |
| Military Construction | 11 | 5 | 6 | 0.75 |
| Other General Government | 23 | 17 | 6 | 0.65 |
| Conservation and Land Management | 12 | 7 | 5 | 0.91 |
| Criminal Justice Assistance | 14 | 9 | 5 | 0.77 |
| Water Resources | 11 | 6 | 5 | 0.55 |
| Central Personnel Management | 10 | 6 | 4 | 0.62 |
| Elementary, Secondary, and Vocational Education | 10 | 6 | 4 | 0.74 |
| Energy Conservation | 6 | 2 | 4 | 0.00 |
| General Purpose Fiscal Assistance | 14 | 10 | 4 | 0.83 |
| General Retirement and Disability | 10 | 6 | 4 | 0.70 |
| Ground Transportation | 12 | 8 | 4 | 0.81 |
| Pollution Control and Abatement | 10 | 6 | 4 | 0.41 |
| Recreational Resources | 10 | 6 | 4 | 0.93 |
| Conduct of Foreign Affairs | 9 | 6 | 3 | 0.98 |
| Health Care Services | 8 | 5 | 3 | 0.99 |
| Legislative Functions | 5 | 2 | 3 | 0.99 |
| Other Labor Services | 7 | 4 | 3 | 0.71 |
| Space Flight, Research, and Supporting Activities | 13 | 10 | 3 | 0.95 |
| Water Transportation | 6 | 3 | 3 | 0.93 |
| Atomic Energy Defense Activities | 9 | 7 | 2 | 0.68 |

| | | | | |
|---|---|---|---|---|
| Emergency Energy Preparedness | 11 | 9 | 2 | 0.73 |
| Energy Information, Policy, and Regulation | 9 | 7 | 2 | 0.84 |
| Federal Correctional Activities | 4 | 2 | 2 | 0.99 |
| General Science and Basic Research | 8 | 6 | 2 | 0.97 |
| Income Security for Veterans | 3 | 1 | 2 | 0.77 |
| Military (1947-1956) | 3 | 1 | 2 | 0.68 |
| Social Services | 7 | 5 | 2 | 0.96 |
| Air Transportation | 9 | 8 | 1 | 0.97 |
| Central Fiscal Operations | 2 | 1 | 1 | 0.97 |
| Consumer and Occupational Health and Safety | 3 | 2 | 1 | 0.99 |
| Federal Employee Retirement and Disability | 5 | 4 | 1 | 0.98 |
| Federal Law Enforcement Activities | 6 | 5 | 1 | 0.99 |
| Food and Nutrition Assistance | 8 | 7 | 1 | 0.99 |
| Military Procurement | 1 | 0 | 1 | 0.87 |
| Other Natural Resources | 4 | 3 | 1 | 0.99 |
| Other Veterans Benefits and Services | 5 | 4 | 1 | 0.95 |
| Agricultural Research and Services | 1 | 1 | 0 | 0.97 |
| Federal Litigative and Judicial Activities | 1 | 1 | 0 | 0.99 |
| Foreign Information and Exchange Activities | 3 | 3 | 0 | 0.88 |
| Health Research and Training | 0 | 0 | 0 | 0.97 |
| Medical Care for Veterans | 2 | 2 | 0 | 0.99 |
| Medicare | 1 | 1 | 0 | 0.99 |
| Military Family Housing | 2 | 2 | 0 | 0.80 |
| Military Operations and Maintenance | 1 | 1 | 0 | 0.97 |
| Military Personnel | 0 | 0 | 0 | 0.92 |
| Military Research, Development, Test, and Evaluation | 2 | 2 | 0 | 0.98 |
| Other Transportation | 3 | 3 | 0 | 0.79 |
| Social Security | 1 | 1 | 0 | 0.99 |
| Total | 726 | 447 | 279 | 0.99 |

Note: Temporary punctuations are correlated with auto-correlation at –0.60.

Table 3.2 is sorted by temporary punctuations, making clear that topics driven by exogenous shocks tend to have the most (disaster relief, farm support), while those topics associated with mandatory programs have fewer (Social Security, Medicare). The column displaying serial auto-correlation shows the continuation of the pattern established with spending

on space flight and disaster relief—frequent temporary punctuations are associated with lower auto-correlation.

## Are Previous Findings Robust?

If much of the instability we observe in budgetary time series can be attributed to policymakers ratcheting up spending to address an unforeseen crisis and then quickly bring it back down to equilibrium or pre-crises levels, this points to a different causal process than is commonly identified in the literature on punctuations. Further, the increasing proportion of the budget that goes to mandatory spending topics suggests that there will be a strong tendency toward incremental adjustments. This raises the possibility that the well-known kurtosis in government outlays is less a function of agenda setting and more attributable to stochastic inputs series and mandatory spending formulas. That is, we observe high leptokurtosis because we combine budget categories that are prone to shocks and incrementalism. Critically, however, the type of change engendered by these categories is not well-explained by traditional ideas about agenda setting and the rise and fall of competing frames. A concern is that by removing these categories from the analysis, isolating the areas of the budget where we do expect agenda setting dynamics to be at work, we can produce a distribution that is much less punctuated, with lower kurtosis.

To investigate this possibility, I reproduce the budget distribution from Figure 3.6 after excluding various budget categories from the analysis. Table 3.3 displays the kurtosis statistics associated with each modified distribution.[6] The first and second row drop the top 3 and top 9 categories for temporary punctuations as identified in Table 3.2. Here, there are only very

[6] Note: I do not eliminate the punctuations, but the entire series associated with the excess temporary punctuations. That is because I am interested in the full distribution of changes, and eliminating the cases in the tails but leaving all other cases would mathematically generate reduced kurtosis, obviously.

marginal differences. The l-kurtosis for the full distribution is 0.62, in the first row it is 0.58, and after dropping the top 9 categories it falls to 0.56. This suggests a decreasing trend to be sure, but in each case the distribution is remains distinctly leptokurtic even after removing the series that could be thought to generate potentially artifactual punctuations. The third row of the table drops mandatory categories, which causes an increase in the kurtosis statistics, and finally the fourth and fifth rows look at the combined effects. In all, there is very little movement in the l-kurtosis statistics across any of the categories. This suggests that the concern is unfounded; a key finding in literature on punctuations—the high kurtosis of budget distributions—is highly robust. Even after eliminating categories prone to incrementalism and stochastic shocks in order to focus more directly on areas of the budget where agenda setting dynamics are most applicable, we find the same pattern of change.

Table 3.3. Kurtosis of U.S. Budget Distribution with Stochastic and Mandatory Series Excluded, 1947 to 2012

| Excluding: | N | Kurtosis | L-kurtosis |
|---|---|---|---|
| Top 3 Categories for Temporary Punctuations | 3,712 | 431.54 | 0.589 |
| Top 9 Categories for Temporary Punctuations | 3,341 | 394.00 | 0.560 |
| Mandatory Spending Categories | 3,118 | 416.93 | 0.632 |
| Mandatory and Top 3 | 3,017 | 400.03 | 0.598 |
| Mandatory and Top 9 | 2,776 | 377.86 | 0.562 |
| Full Distribution | 3,831 | 467.76 | 0.621 |

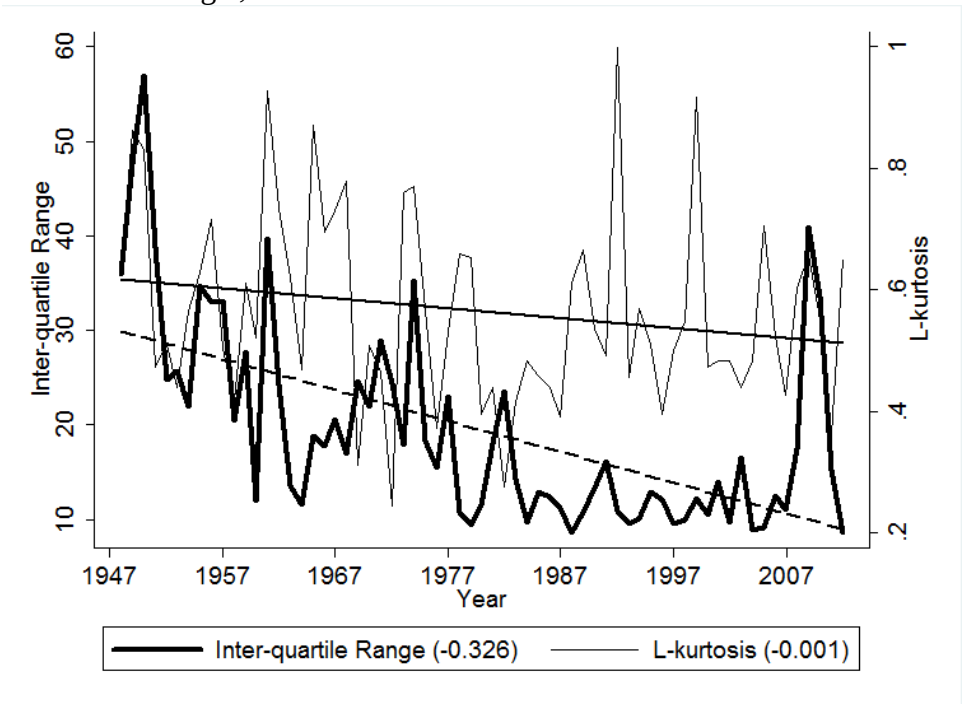
Note: Excludes lagged values less than $50 million

The finding of high kurtosis in budget series appears ubiquitous, but is it becoming less so over time? Jones, Baumgartner, and True (1998) have demonstrated a general secular decline in the volatility of budgets over the decades from 1948 to the recent period. This trend can be attributed to the increasingly large proportion of outlays that are determined by mandatory formulas. As more of the budget becomes insulated from the agenda dynamics thought to cause punctuations, might kurtosis decrease over time? Does kurtosis track volatility?

Figure 3.9 plots the inter-quartile range of the percent change values across all 66 budget categories for each year of data on the left-axis, while the right shows annual levels of l-kurtosis[7]. This replicates the general decline in volatility noted by Jones et al. in 1998; note however the surge in volatility corresponding to the 2009 stimulus bill. The l-kurtosis statistic, while also volatile, shows no clear decreasing trend. The estimated best fit lines for both measures support the visual interpretation. As the coefficients (included in the legend to the figure) indicate, l-kurtosis declines only marginal with time, while volatility decreases at a relatively steep rate. The is reassuring that the high kurtosis observed in budget data is not a relic of a previous era, but persists even as a greater proportion of the budget is determined by spending formulas. Kurtosis statistics require many observations to be robust, so authors have shied away from estimating them, for example, on 60 annual series. When I do so as in this figure, it is with some caution and with a goal of estimating whether the trend is sharply downwards, as is volatility. The answer is that volatility has been declining progressively over time, but kurtosis has remained steady.

[7] The figure uses inter-quartile range rather than a direct measure of variance as it is robust against the extreme outliers pervasive in budget data.

Figure 3.9. Tracking the Annual Inter-quartile Range and L-kurtosis of Percent Changes Values in the U.S. Budget, 1947 to 2009




## Discussion

Punctuated equilibrium is an increasingly popular approach to understanding policy change, not just in a budgetary context, but across a range of organizational outputs. Given the explanatory power of this idea, its wide assimilation through the literature, and its prominence in this dissertation, it is important to be sure that its central empirical findings are robust. Here I have identified what could be a major concern: that the dichotomy between incremental and punctuated changes that the theory explains as the result of shifting political commitments, is in fact artifactual. The counter-hypothesis is that we observe incrementalism because much of the budget is tied to slow-moving demographic indicators, and we observe punctuations because certain budget categories are linked to highly stochastic input series. Combining these factors with a distributional approach would produce leptokurtosis, but not through the mechanism identified by punctuated equilibrium theory. After conducting various robustness tests I can

report that this concern is unfounded. Removing potential sources of measurement bias from the data does little to alter the shape of budget distributions and the same predictive elements remain statistically significant. Further, the finding of high kurtosis is robust with respect to time; it remains high even as mandatory spending makes up a larger proportion of the budget.

The findings from the chapter contribute beyond the support they lend to punctuated equilibrium theory. Most important is the discovery that many of the punctuations observed in government budgets are short-lived and see reversals within only a few years. Given the large proportion of such cases, and in line with the question that John and Bevan (2011) addressed in their paper, one could wonder whether the distributional approach to the study of punctuations simply has too much error built into it to be worthwhile. My analysis suggests that the findings remain robust even when we recognize and control for relevant causal processes that could generate significant numbers of "false" or temporary punctuations.

## CHAPTER FOUR: REVENUE POLICY: A CASE STUDY IN COMPLEXITY

Chapter 2 looked at specific indicators and governing conditions as causes of policy instability. A more general set of indicators that decision-makers may clearly take into account when constructing budget plans is revenues. Federal decision-makers are concerned about deficits, even if they are not required to maintain a balanced budget. However, most states have balanced budget provisions. Few have studied kurtosis in tax revenues, but these may be a powerful predictor of the observed and well-known kurtosis in outlays. The availability of revenue is closely associated with economic fundamentals. Ideally taxes are designed to grow at least as quickly at the economy, while insulating governments from economic shocks. Tax revenues therefore represent something of a middle ground in the budgetary process – an output of the policy making process, they are directly affected by economic conditions and serve as an input to expenditure decisions.

The chapter leverages the central role revenues play in budgeting to test various hypotheses about government information processing. A central finding of the chapter is that like outlays, revenue distributions are 'fat tailed.' A comparison of revenue distributions to underlying changes in the economy reveals clear evidence of the 'ratchet effect' whereby the inefficiencies of policy making transform inputs into fat tailed outputs. Given the political difficulties of adjusting tax rates, we can expect that policymaking will be especially contentious when it comes to raising revenues. Consistent with this hypothesis, distributions of changes in revenues tend to be more extreme than outlay distributions. Furthermore, variance in the degree to which changes in state outlay distributions display extreme values can be explained, in part,

through revenue distributions. In all, an examination of government revenues provides a clear and novel demonstration of the punctuated equilibrium framework at work.

## Revenue Distributions

The chapter employs data on government revenues from two sources. Data on federal revenues comes from the OMB, which tracks federal receipts from taxes as well as money received from custom duties, sales of various assets, and other financial transactions, from 1934 through 2011. For the state-level analysis, the chapter uses a U.S. Census Bureau dataset that tracks state revenues from 27 different types of tax from 1965 through 2008. Figure 4.1 shows the distribution of annual changes to revenues received by the federal government, revealing that revenues, like outlays, form leptokurtic distributions.

Figure 4.1. Federal Government Revenues, 1934 to 2011

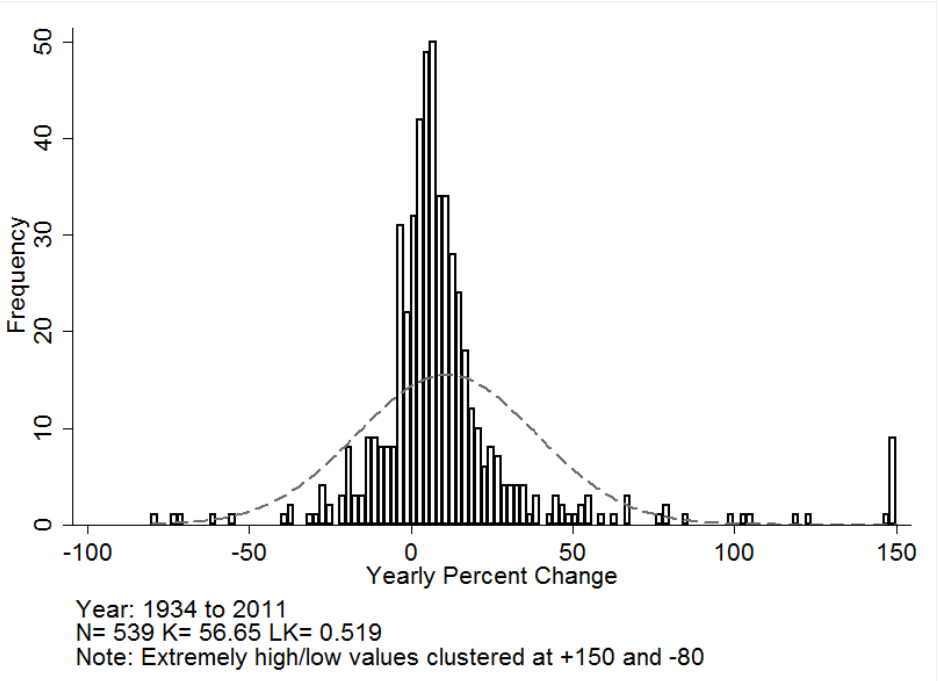
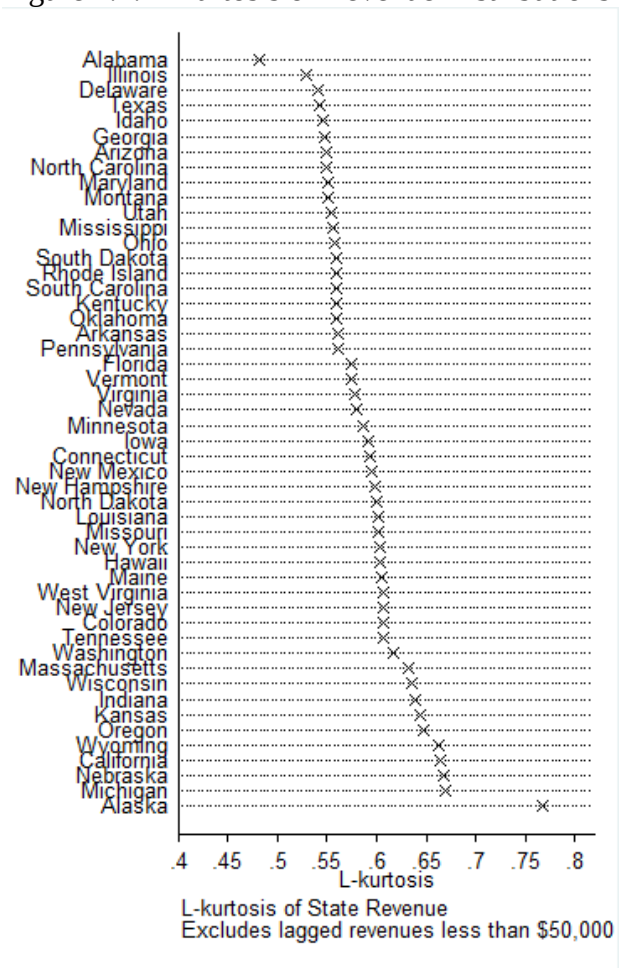



Figure 4.2 plots the l-kurtosis values associated with the revenue distributions for all 50 states. For each state, this value is well above the 0.123 associated with the normal distribution; ranging from 0.407 (South Carolina) to 0.983 (Connecticut). So at both the federal and state

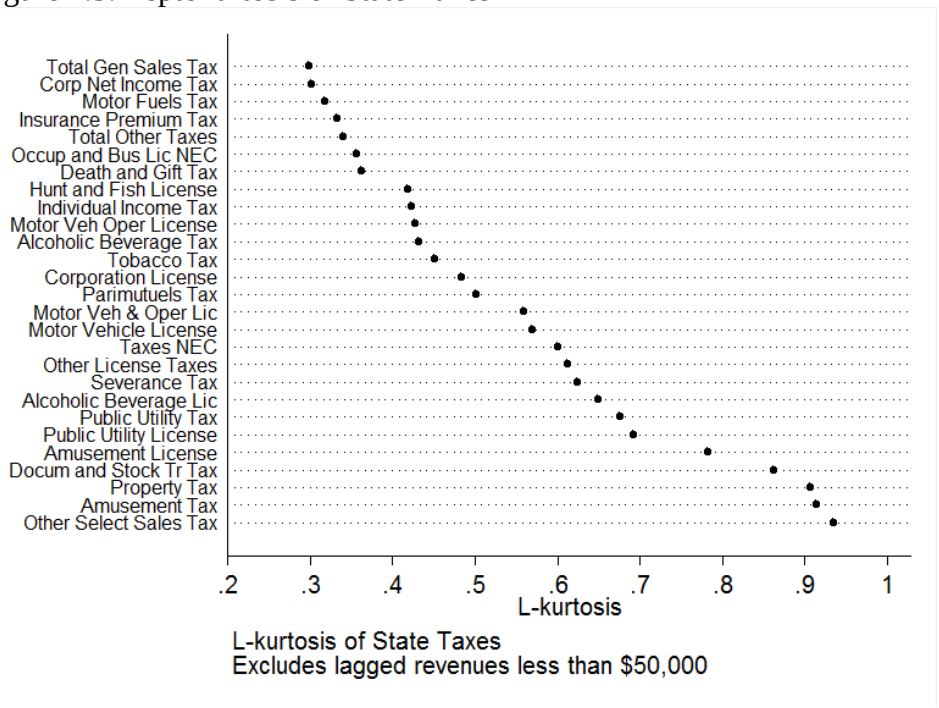
levels, revenue distributions show high kurtosis. This is not surprising as the policies that determine how taxes and other sources of revenue will be collected are subject to same information processing that leads to patterns of under and over-reaction in outlays. Instability in revenues can be seen as a particularly problematic feature of modern government. Figure 3.1 reveals that in some years the revenues associated with certain federal taxes decreased by upward of 50 percent. The large l-kurtosis values associated with state-level distributions indicate that changes of a similar magnitude are relatively common among the 50 states as well. In many cases these dramatic negative shifts may represent a catastrophic failure in revenue, which would certainly impede the government's ability to implement public policy or make reliable budget plans.

Figure 4.2. L-kurtosis of Revenue Distributions for the 50 States, 1965 to 2008




Chapter 2 showed that instability varies widely across policy domains, with areas based on relatively simple indicators showing fewer punctuations than those domains that are based on unstable or controversial inputs. The Census Bureau dataset tracks revenues from 27 different taxes employed by the states, so I follow a similar line of inquiry with the revenue side of budgets by measuring the leptokurtosis of each tax distribution, aggregated across all 50 states. The data includes revenues from all of the major taxes employed by the states – sales, property, income – as well as more esoteric categories that do not see wide usage, such as 'amusement taxes' which are sometimes included as admission charges for recreational events. Figure 4.3 displays the results.

Figure 4.3. Leptokurtosis of State Taxes




Clearly some taxes are much less likely to see an extreme change in the amount of revenue they provide than others. Particularly stable taxes are the general sales tax, motor fuels tax, and corporate income tax. On the other side of the scale are the property and amusement tax, which with very high l-kurtosis values, undergo frequent punctuations. When designing a tax, state legislatures are interested in the amount of revenue it will generate, but also how stable that revenue will be over time. It is much easier to base long-term budget plans around predictable taxes, than on taxes that see high variability from one year to the next. Further, certain taxes may be linked to particular expenditure items. For example, in most states property taxes pay for public education. The high level of l-kurtosis associated with property taxes can help explain why many states find it difficult to adequately fund their public schools. Most of taxes in Figure 4.3 are only small contributors to overall state revenues, however. High instability for these relatively minor taxes should have little effect on state budgeting. Notably, the two largest

sources of revenue for most states are the individual income tax and the sales tax, which have comparatively low l-kurtosis values.

## From Economic Fundamentals to Revenues

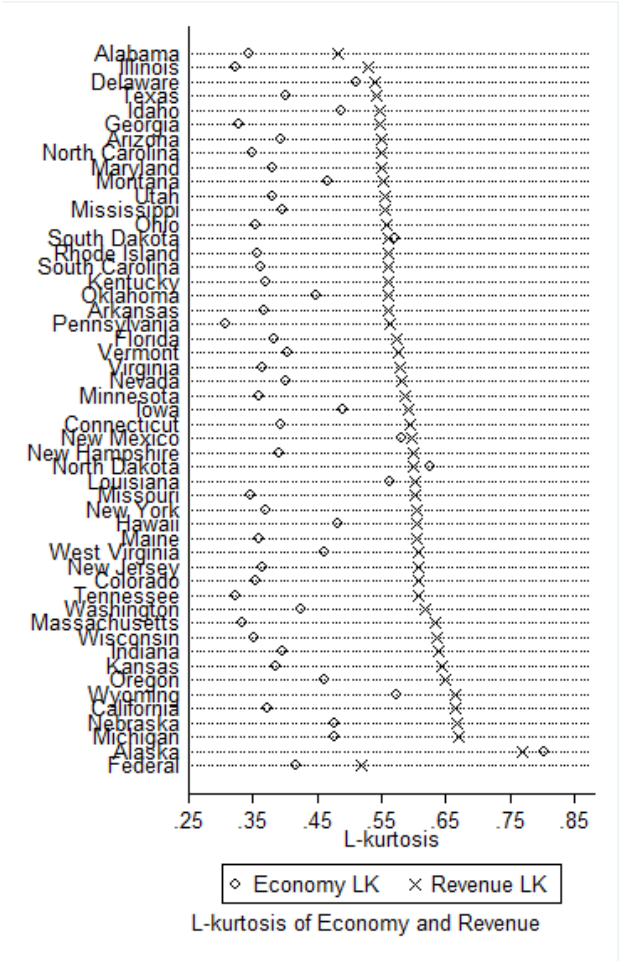
The amount of revenue a government receives in a given year is highly dependent on economic fundamentals. Individual and corporate income taxes vary according to the business cycle; when unemployment is low, governments receive more revenue through these taxes than when unemployment is high. The sales tax, a major source of tax revenue, is also highly correlated with economic conditions, as people buy fewer consumer goods during economic downturns. Government revenue is therefore another area of policymaking where it is relatively straightforward to compare distributions of outputs with inputs, in order to directly assess the effects of disproportionate information processing.

Jones, Sulkin, and Larsen (2003) show that aggregate changes in stock market returns approximate a normal distribution. Instead of stock markets, the chapter looks at Gross Domestic and Gross State Product as measures of underlying economic conditions. As with markets, however, aggregate measures of economic productivity are based on the collective actions of many individuals and businesses, so we can expect that changes to GDP or GSP will be closer to the normal than distributions of outputs that are based on governmental decision-making. Economic conditions clearly affect the availability of government revenues, but ultimately, revenues are determined by public policy. By comparing the shape of economic and revenue distributions, the chapter can assess the degree to which government deliberations increase the instability of outputs, beyond what could be expected based on the inherent instability of a particularly relevant input.

Figure 4.4 shows the l-kurtosis associated with economic and revenue distributions for

the 50 states, and in the last row of the figure the federal government. In all but 3 cases the distribution associated with government revenues is more extreme than the corresponding economic distribution. This is evidence of the 'ratchet effect' where the inefficiencies of government (both cognitive and institutional) transform an input into a fat-tailed output.

Figure 4.4. Comparing the Shape of Economic and Revenue Distributions for the 50 States and the Federal Government




In each case, the government receives a mix of tax revenues based on economic activity and rates of taxation, but economic activity evolves slowly, which eventually puts strains on the budget. There are strong reasons to expect that governments will not be able to adjust the tax rates proportionately to these shifting fundamentals. Instead, the system may be allowed to limp along until a more dramatic adjustment takes place or a sudden crisis forces a change. As Figure

4.4 makes clear, some states have revenue distributions with much greater l-kurtosis values than others. One possible explanation is that each state relies on different economic fundamentals, for example relying on mineral extraction taxes in some cases but broad personal and corporate income taxes in others. However, Figure 4.4 shows no clear relationship between instability in economic fundamentals and the l-kurtosis of revenue distributions. There is no reason to expect that each state, or the federal government, will be equally efficient in shifting its many tax rates in order to maintain stability in receipts, so the variance observed in Figure 3.4 may only tangentially relate to differences between state economies.

As discussed, high l-kurtosis in revenue distributions is evidence of what in many cases would be a catastrophic drop in receipts. Figure 4.4 shows that, far from insulating governments from economic shocks, revenue policies appear to exacerbate the changes taking place in the underlying economy. In almost every case, government revenues undergo extreme changes far more frequently than would be expected from shifting economic conditions alone[8].

## From Revenues to Expenditures

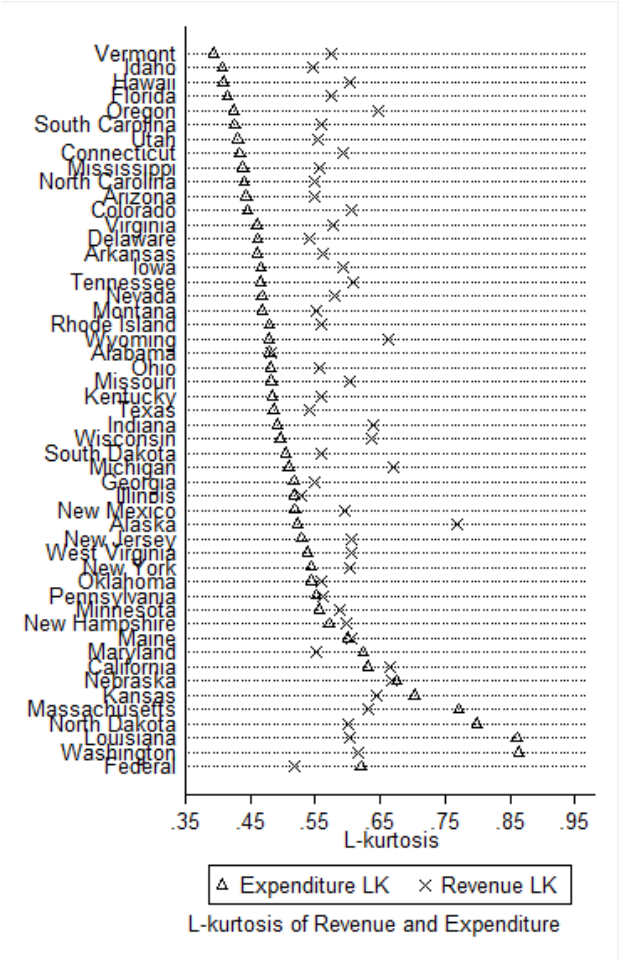
Revenue policy provides a direct avenue for testing ideas about complexity and instability. As sticky as expenditure decisions may be, changing tax rates is even more politically difficult. Revenues are of course essential to the functioning of government and implementation of public policy, but taxes are deeply unpopular. It is therefore with great reluctance that decision makers will seek new avenues for raising revenue. On the other hand, cutting taxes, while politically popular may be fiscally untenable, especially among the states that to varying degrees

[8] High l-kurtosis values also mean dramatic upticks in revenues, as the fat tails extend in both directions, so sometimes receipts grow at a much faster rate than economic fundamentals. States try to implement taxes that will produce more revenue over time and dramatic increases in receipts can certainly be a boon for state budgets. But implementing these taxes is a high-risk, high-reward strategy. Taxes that produce large positive punctuations are also more likely to see dramatic changes in the opposite direction.

require balanced budgets. Further, economic cycles often take policymakers by surprise, so there is a great deal of real-world uncertainty to contend with. If economic models were better at predicting the course of the nation's economy, or there was more political consensus over tax rates, then setting revenue policy would be relatively simple. As it stands, given the comparative complexity – both natural and political – of setting revenue policy, the expectation is that distributions of changes in government revenues will be prone to greater instabilities than distributions of government outlays.

Figure 3.5 tests this hypothesis, comparing the l-kurtosis of revenue and expenditure distributions for the 50 states and the federal government. In 42 out of 51 cases, revenues have higher l-kurtosis values than expenditures. Some governments will be more or less efficient at adjusting revenues than others, which may explain why the results do not unanimously support the hypothesis, but the bulk of cases show the expected relationship. Revenues consistently see more punctuations – both positive and negative – than expenditures.

Figure 4.5. Comparing the Shape of Expenditure and Revenue Distributions for the 50 States and the Federal Government




## Predicting Stability in Government Expenditures

While the size of federal and state budget deficits indicates that the link between revenues and expenditures is far from ironclad, scholarship does suggest that the availability of revenue affects spending decisions at the national and state level (Friedman 1978; Manage and Marlow 1986; Ram 1988; Blackley 1986). This is especially true for the states, where balanced budget amendments require some level of correspondence between the two sides of the budget[9] Revenues, aside from providing an avenue for testing hypotheses about government information

[9] The details of balanced budget amendments vary considerably across the states. Some merely provide procedural incentives to maintain balanced budgets, while others make it a constitutional requirement.

processing, may also be a powerful predictor of kurtosis in government outlays.

The chapter estimates a model using OLS regression to predict variance in the l-kurtosis of state expenditure distributions. (The dependent variable is on display in Figure 4.5.) The key independent variable is the l-kurtosis of state revenue distributions and the predication is simply that greater leptokurtosis in revenue will be associated with higher l-kurtosis in spending. Four additional variables of substantive interest are included in the model.

The first is a categorical variable that divides the states into quintiles based on the mean size of their expenditures. We might expect that states with lower mean expenditures will see more extreme changes in spending, as it is comparatively easy to make large adjustments to programs receiving fewer total dollars. For instance, a 100% increase to a program with a base expenditure level of $100 is, in total dollars, several orders of magnitude less substantial than a 100% increase to a program with a base of $1 million. On the other hand, states with higher mean expenditures tend to be larger, with diversified populations and industries. Heterogeneous states may place greater demands on the information processing capacity of governments, exacerbating the dichotomy between incrementalism and punctuations.

Another factor that might affect the l-kurtosis of expenditure distributions is economic fundamentals. Much of this effect may be indirect, as shifting economic conditions have immediate implications for state revenues. A direct effect between GSP and expenditures is also possible, however. Policymakers might anticipate changing economic fortunes and adjust spending levels before the new economic reality manifests itself in revenues. The model includes a variable for the l-kurtosis of GSP distributions, with the expectation that greater instability in economic fundamentals will lead to instability in expenditures.

Starting in the 1960s state legislatures began to professionalize, leading to longer

legislative sessions and endowing legislators with resources – both fiscal and organizational – to facilitate the process of lawmaking. Professionalization is essentially an effort to increase the agency of legislators, allowing them greater access to information and expertise (Mooney 1995). Of course, not every state has a 'professional' legislature. The model includes a categorical variable that divides state legislatures into fully-professional, semi-professional, and non-professional based on demarcations provided by the National Conference of State Legislatures (NCSL 2009), with higher values indicating a more professional legislature. As professionalization is closely linked to the capacity of decisions makers to process information, the expectation is that states with professional legislatures will see fewer spending punctuations[10].

Finally, the model includes a categorical variable measuring the strictness of state balanced budget amendments, with higher values indicating stricter requirements. Once again the NCSL provides a three-tiered demarcation to distinguish between the states. Generally, states with the strictest amendments prohibit carrying debt forward across fiscal years, require that the governor propose a balanced budget, and that the legislature pass a balanced budget. The states with the least stringent amendments may have an amendment requiring the governor to submit a balanced budget, but do not demand that the legislature actually pass a balanced budget (NCSL 2010). The strictness of balanced budget amendments may clearly affect the relationship between expenditures and revenues, so it is an important control to include in the model. Table 4.1 shows the results.

[10] The professionalism of state legislatures is mostly constant over time, with states only rarely changing categories.

Table 4.1. Predicting L-kurtosis of State Expenditure Distributions

| Variable | Coefficient | Standard Error |
|---|---|---|
| Expenditure Quintiles | 0.06* | 0.02 |
| Revenue L-kurtosis | 0.24* | 0.11 |
| GSP L-kurtosis | 0.01 | 0.44 |
| Professional Legislature | -0.10* | 0.03 |
| Balanced Budget Amendment | -0.02 | 0.02 |
| Constant | 0.03 | 0.03 |

N = 50
Adjusted R2 = 0.193
* = significant at 0.05 p-value

Three of the five substantive variables are statistically significant. States with higher mean expenditures tend to have expenditures distributions with fatter tails, although the effect is only modest. This may be due to the increased complexity brought on by the diversity of policy considerations in larger states. At the very least, the results are reassuring that variance in l-kurtosis is not caused by extreme changes among states with low total expenditures; a statistical, but theoretically uninteresting possibility. As expected, the coefficient for l-kurtosis in state revenue distributions is positive and significant. Clearly revenues deserve to be part of the on-going discussion in the literature about the causes of punctuations in government outlays.

The coefficient for the l-kurtosis of GSP distributions is not significant, indicating that economic fundamentals do not have a direct effect on patterns of state spending (although they may certainly have an indirect effect through revenues). Likewise, the coefficient for balanced budget amendments is both very modest and statistically non-significant. But legislative professionalism has a powerful effect on the shape of expenditure distributions; states with more professional legislatures are less likely to see spending punctuations. This result has both theoretical and practical implications. It provides a relatively direct test of the theory of disproportionate information processing Jones and Baumgartner advance. Professionalism is closely linked to legislatures' capacity to process information, so the finding is supports a basic

prediction of the theory. Second, it advances the discussion about the merits of professionalization, as budget instabilities are often seen as undesirable and professionalism can be viewed as a partial solution to this problem.

## Discussion

The chapter advances the study of information processing and instability in American politics in two ways. First, the chapter demonstrates that l-kurtosis in state revenue affect the shape of spending distributions. At face value, the result is not surprising, as the link between revenues and expenditures at the state level is well-recognized. However, this connection has gone unexplored in the literature on punctuated equilibrium, which focuses predominantly on budgetary outcomes, but has never attempted to incorporate the revenue side of budgeting. As it happens the well-documented instability in expenditures can be closely linked to revenue policy. Of course, disproportionate information processing can be seen as the root cause of instability in both cases, but any attempt to explain punctuations in government spending must take seriously the possibility that many extreme changes are simply a reaction to evolving revenue policies. An investigation of government receipts also provides a window into what is a highly complex area of policymaking. The chapter documents a corollary between complexity and instability such that increasing complexity can be linked to more dramatic policy changes.

Second, the analysis provides a general test of punctuated equilibrium theory by comparing the shape of expenditure distributions across different conditions thought to influence a government's aptitude to process information. Of particular relevance is the finding that legislative professionalism – a factor that relates directly to the information processing capacity of governments – is a powerful predictor of leptokurtosis in spending distributions.

## CHAPTER FIVE: PUBLIC INFORMAITON PROCESSING

To this point, the dissertation has sought to explain the causes of instability in government policy. Now the focus shifts to another major component of the American political system – the public. In any functioning democracy, policymaking takes place at the intersection between representatives in government and their constituents, so there is a possibility that many dramatic policy changes are simply reactions to shifting public sentiments.

Mass publics are politically sophisticated - meaning that they respond to political stimuli such as presidential elections, wars, or major policy initiatives - because they gain by aggregation. Through aggregation, random behavior by people not paying attention to politics averages out, leaving a clear signal from those who are attuned and responding to political events. It would be difficult to overstate the importance this empirical fact has had for modern studies in public opinion. It is the bedrock on which electoral outcomes are predicted and the direction of public policies assessed; public opinion is an indispensable explanatory variable. Beyond sophistication, what else do we know about the characteristics of mass publics? Surprisingly little, given the powerful influence they exert on political outcomes. By incorporating literature on bounded rationality, I develop a model of public information processing. The key theoretical argument is that because cognitive limitations are relatively constant there is little to gain by aggregation, so public agendas, the scope of issues to which the public attends, will be highly constrained.

The implications appear quite substantial. The punctuated equilibrium model establishes a direct corollary between agenda scarcity and political instability, and bounded rationality is the

centerpiece of this model; causing governments to under-attend to most issues and over-react to a small set of issue where a crisis seems apparent. If my model of public information processing is correct, then we should observe a similar pattern in public opinion. I use public policy mood, as developed by James Stimson (1991), to test this expectation. Analysis of public mood in relation to media coverage reveals that when attention is concentrated, there is the possibility for large surges in opinion, but in the absence of attention movement in opinion is only marginal. If public attention is a scarce commodity, then movement in opinion will be predominately incremental, with occasional punctuations on issues where attention is focused.

This finding supports previous scholarship, which characterizes opinion change as, alternatively, smooth and gradual, or sudden and dramatic. The benefit of the chapter's approach is that an understanding of how cognitive limitations constrain the scope of public attention can account for both types of opinion change, offering a concise and unified explanation of movement in public opinion. Most important, the results advance the conversation about the nature of mass publics by establishing that, although sophisticated, they are still boundedly rational. Both characteristics are important for understanding opinion change. By responding to political stimuli the public plays an important role in representative democracy, but agenda constraints mean that opinion change is inherently dichotomous; publics will either behave idiosyncratically on issues that fail to cross some threshold of urgency or respond dramatically to those that do. Public responsiveness may be sophisticated, but it lacks precision.

The chapter unfolds as follows: the first section reviews scholarship relating to public opinion, paying particular attention to existing models of opinion formation and change. The second section introduces two hypotheses about patterns of change in public opinion, clarifying

the type of empirical evidence we should observe if they are verified. The third section tests the hypotheses using public policy mood in conjunction with data on media coverage.

## Opinion Formation

The Converse-Zaller model of opinion formation proposes a two stage process. For opinions to change, new information must first be received and then accepted. Receiving a message requires both exposure and comprehension, while acceptance means adjusting one's opinions to match the content of the message. So the likelihood of a person changing their opinion is a function of the probability that she receives a message and then accepts it (Converse 1962; McGuire 1969; Zaller 1993). This process is conditioned by political awareness. Higher levels of political awareness increase the probability of someone receiving a message (as becoming informed about politics requires a person to pay attention to political messages in the first place). At the same time, higher levels of awareness make people less likely to accept a message (as well informed individual tend to have more concrete political values and expectations).

In a later publication John Zaller (1991) adds nuance to the two stage model by considering how mixed messages and political values affect the likelihood of opinion change. He demonstrates that variance in the strength and consistency with which people hold their political beliefs can be attributed to the interaction between levels of political awareness and the relative intensities of competing political messages. Depending on the context, people with low levels of political awareness may be more likely to change their opinion than their highly aware counterparts (Zaller 1991).

These individual level findings have implications for understanding changes in aggregate public opinion. Only some of the public has to change their opinion for movements in

aggregate opinion to appear orderly (i.e. responsive to elections, public policies, and other political stimuli) (Stimson 1991; Page and Shapiro 1992; Stimson 1999; Erikson, MacKuen and Stimson 2002). This can be explained through aggregation gain, where random fluctuations in the opinions of uninformed citizenry average out, leaving a clear signal from the minority of citizens who are actually paying attention and responding to political stimuli (Stimson, 1991, 2004). Different groups will be paying attention to different issues. Based on research by Zaller we can expect that the question 'who moves public opinion' will have different answers depending on contextual circumstances, such as the tone and intensity of media messages and the amount of elite discourse.

Numerous articles consider the nature of changes in public opinion. In a 1982 article, Benjamin Page and Robert Shapiro conclude that within their dataset, "Most changes were gradual. Only rarely did preferences fluctuate back and forth to a statistically significant extent within a short period" (1982, 40). Indeed, the basic dichotomy from the Converse-Zaller model suggests that opinions may be relatively stable, as change requires people who are politically aware enough to receive messages, but not so politically aware as to have inflexible political beliefs (Zaller 1992). James Stimson, in his 1991 *Public Opinion in America*, argues that the public is largely indifferent about most policy changes. He infers a 'zone of acquiescence', within which the costs of staying informed about public policy outweigh the potential benefits to the public. So while movement in public opinion is orderly, it is also notoriously slow to respond to political stimuli and not very sensitive. Of course, some messages resound louder than others, so sometimes even people with low levels of political awareness will receive the message. In these cases we can expect more dramatic movements in opinion (Zaller 1993). As Stimson

theorizes, policy making that takes place outside the zone of acquiescence can lead to serious backlash and sudden surges in public opinion.

## Public Information Processing

Scholars of opinion change document evidence of both incremental drift and sudden surges in opinion. These findings resonate well with results in the literature on agenda setting, where policy change is thought to be a predominantly static process that is occasionally punctuated by episodic adjustments. My argument is that these similarities are not coincidental, but have a common root in bounded rationality, which causes attention scarcities in both cases.

In many ways models of opinion and policy change are similar, with both traditions placing a priority on attention. Without first attending to a message, systematic change is impossible. Both traditions are also careful to acknowledge that attention is a necessary, but not sufficient condition for change. As the Converse-Zaller model makes clear, people can receive a message but then choose to reject it, and issues often make it on the government agenda only to end in deadlock. Central to the punctuated equilibrium model is the idea that cognitive and institutional limitations make the government a disproportionate processor of information, creating widespread attention scarcities. Can we apply the same logic to the public? On the one hand, public information processing is not limited by institutional bureaucracy. Opinions can change as dramatically and frequently as people choose to change them. There are, however, good reasons to expect that cognitive limitations will apply to the public at least as strongly as they apply to governments.

My model of public information processing is straightforward. Taking what we know about bounded rationality and applying the principals of aggregation gain implies that the public

agenda will be highly constrained.[11] Why is this? Why do mass publics gain sophistication through aggregation, but not agenda space? The key is variance or a lack thereof when it comes to attention. People have dramatically different levels of political sophistication, but bounded rationality is ubiquitous. This means that the scope of each person's agenda is relatively constant, and there is nothing to gain when aggregating over a constant.

As illustration, imagine a survey asking every American to list issues they are concerned about, in no particular order. In accordance with bounded rationality, we can expect that each respondent will list five to ten different issues (and probably not 100 or 1,000 different issues). Across every American a wide range of issues will be represented, but upon aggregating an orderly signal will emerge, with the frequency of issue responses rising and falling in accordance to contextual circumstances. In other words, responses will not be evenly distributed, but rather cluster around a small subset of issues to which particular urgency is attached. Critically, because cognitive limitations are universal they will survive the aggregation process, constraining the number of issues that can be considered highly salient. In all, the scope of the public agenda will closely resemble the scope of individual agendas.

Note, however, that the content of the public agenda should be sophisticated, in the sense that it will reflect contemporary political issues. But the number of issues on the agenda that can be considered salient should be limited to approximately 5 to 9; the number of unique issues cognitive psychologist estimate people can attend to at one time. A constrained agenda means that public attention will inevitably be a scarce commodity. For those issues that are the focus of the public's limited attention, substantial shifts in opinion will be possible (although by no means

[11] As noted, the public agenda, as we use the term, refers to the public's issue priorities, the subset of politically salient problems to which the public attends. Issues on the public agenda can be considered 'highly salient', meaning simply that they are issues of prominence to the public.

guaranteed). Most issues, however, will not make the public agenda and will go under-attended. For these issues public opinion may drift marginally, but in the absence of attention, it is hard to imagine how large systematic shifts would be possible. Of course, issues can become more or less salient over time, but while the subset of highly salient issues can change, the number of issues on the public agenda should be relatively stable, so issues will displace each other as they rise and fall in urgency.

Hypothesis 1: *Public opinion will match a punctuated equilibrium pattern of change, where predominantly incremental shifts are occasionally interrupted by large changes.*

Hypothesis 2: *Changes in opinion will follow attention, with large changes being more likely for issues that are highly salient to the public.*

If the first hypothesis is to be confirmed, then the distribution of changes in public opinion must feature very wide tails and a tall central peak, with mid-level changes largely absent from the data. This would indicate that changes to opinion are mostly incremental, but that occasionally dramatic surges in opinion take place. Confirmation of the second hypothesis would show that movement on the public agenda predicts the magnitude of opinion changes.

## Data and Analysis

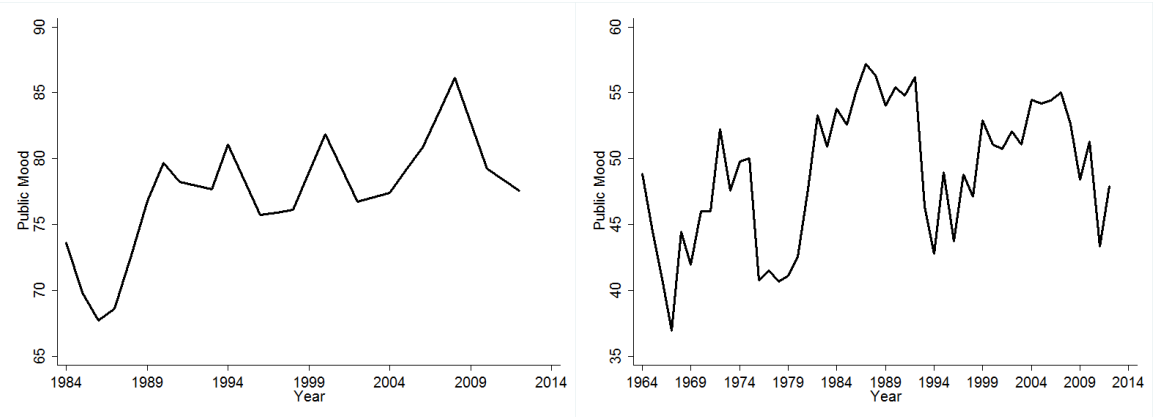
The analysis uses public policy mood as a measure of public opinion. Introduced by James Stimson in his 1991 *Public Opinion in America,* public mood is created by aggregating survey questions to isolate respondents' latent attitudes about the size of government. These attitudes reduce to a single dimension – more or less government, with higher mood values indicating a public that wants more government intervention and lower values a public that favors a diminished role for government. An advantage of public mood is that aggregating across multiple surveys minimizes the effects of survey error, allowing a more accurate assessment of public opinion. Previously this measure has been used by James Stimson in various publications

(1991; 1995; 2002; 2004). The general mood measure is also available broken down into 44 specific policy topics, which track opinions over varying periods of time between 1946 and 2012. Breaking the general mood measure into its component parts allows a larger-scale assessment of the distribution of changes over time. Altogether, there are 1,584 observations (Data available on policyagendas.org).

As an example, Figure 5.1 displays public policy mood for mass transportation (left panel) and assistance for low-income families (right panel), two out of the 44 available topics. The mood measure can vary from 0 to 100, with 0 being the most conservative possible mood and 100 the most liberal. In the left panel, however, the measure varies only from approximately 67 to 86, indicating the public strongly favors more government intervention when it comes to developing mass transportation systems. The story is very different when it comes to assistance for low-income families. Mood fluctuates between 37 and 57, suggesting that the public is less enthusiastic about government interventions to help struggling families.

Figure 5.1. Public Policy Mood for Mass Transportation and Assistance for Low-income Families

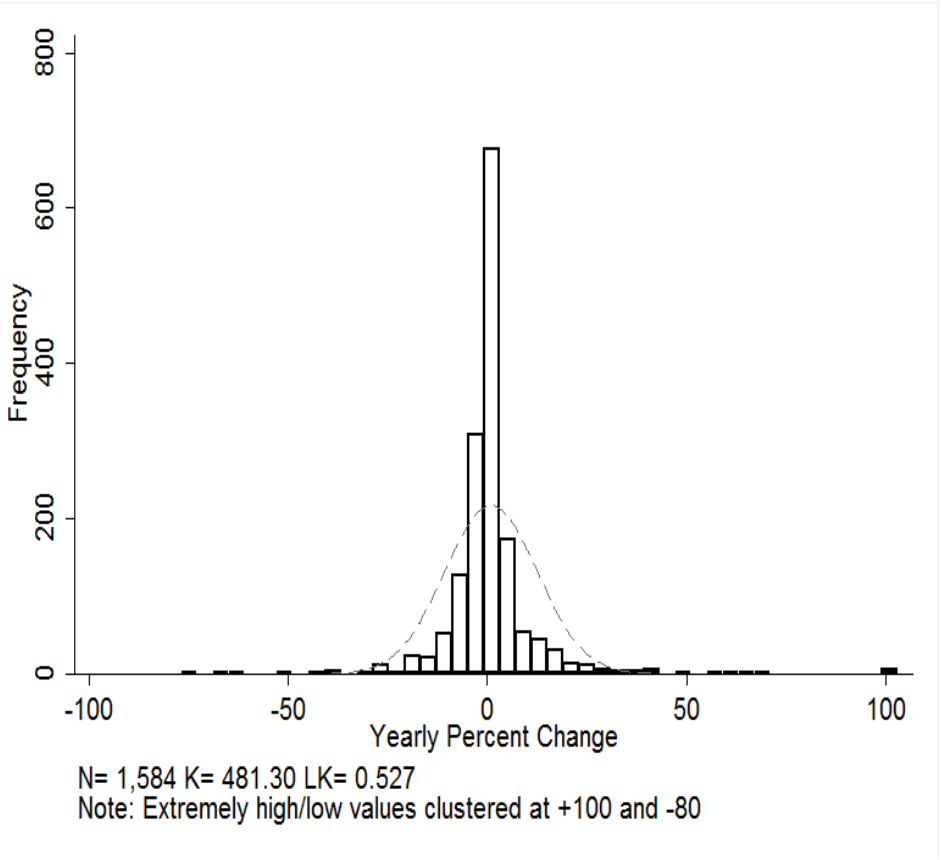
a) Mass Transportation b) Assistance for Low-income Families




Taking the annual percentage changes in mood for each of the 44 topics and aggregating them together produces the distribution on display in Figure 5.2. Clearly the distribution is not

normal, but instead features the high central peaks and wide tails indicative of a leptokurtic distribution. (Superimposed over the mood distribution is a normal distribution, for comparison.) This is borne out by the l-kurtosis value, which at 0.527, is well above the value associated with the normal distribution.

Figure 5.2. Annual Changes in Public Policy Mood, 1946 to 2012
a) Mood Distribution




The evidence points clearly toward public opinion (as measured by public policy mood) following a punctuated equilibrium pattern of change. Most changes are only incremental, but occasionally the public drastically adjusts its expectations of government. Finding support for the first hypothesis, the chapter turns to the second. Do large changes result from a concentration of attention on a particular topic? Do opinions drift when attention is diffuse?

## Measuring the Public Agenda

The chapter uses levels of media coverage as a proxy for the public agenda with the expectation that issues receiving high levels of coverage are likely to be highly salient to the public.[12] The approximation is not perfect, as it is conceivable that media and public agendas will sometimes differ (Erbring, Goldenberg and Miller 1980). However, as a long series of scholarship makes clear, public opinion and media coverage are closely related, with the intensity and tone of coverage thought to influence movement in public opinion (McCombs and Shaw 1972; Cook et.al. 1983; MacKuen 1984; Page, Shapiro and Dempsey 1987; Kellstedt 2003; Barabas and Jerit 2009). Further, both the public and media react to the same stochastic events, such as wars, government spending, or elections. So there are good reasons to think our expectation is realistic.

Media coverage is measured using LexisNexis keyword searches, which allow researchers to track the appearance of certain words or phrases in news stories over time. A chief concern when using this approach is the viability of the search terms, or the degree to which they return coverage relevant to the topic of interest while passing over extraneous stories. The more specific or esoteric a topic, the easier it is to develop meaningful keywords. Out of the 44 topics for which mood data is available, 12 were selected, through trial and error, as sufficiently narrow to develop viable keywords. In developing search terms, more emphasis was placed on avoiding false hits than on covering the full range a topic. To test the viability of the terms, random

[12] Previous scholarship uses Gallup's Most Important Problem (MIP) poll as a measure of the public agenda (Miller et.al. 1976; Jones 1994; Soroka 2002). This classic polling series asks survey respondents to name the most important problem facing the country, thus providing a relative measure of the importance the public places on different issues. There are however some well-established limitations to the MIP poll, the most serious of which is that it is ambiguous what the word 'important' actually means to respondents (Wlezien 2005). The other consideration that makes MIP data unsuitable for the current analysis is that the traditional coding of the MIP responses aligns poorly to available public policy mood topics. There are simply not enough congruent topic areas for robust time series analysis.

samples of the results were read and if more than 15% of the sampled articles were extraneous to the topic, the terms were rejected and new ones developed. If after multiple iterations of this process no search terms could be found that brought the proportion of false hits below 15%, then the topic was rejected for this analysis. For example, there is data on the public's mood about "elementary and secondary education," but there are so many dimensions to this topic that developing accurate search terms is very difficult. Journalists talk about this issue in hundreds of distinctive ways. On the other hand, it is more straightforward to develop search terms for the "unemployment rate" because the vocabulary associated with this issue is relatively specialized.

The final keywords were used to search LexisNexis for stories in *The New York Times* from 1980 through 2010. This source was selected for its national prominence and because LexisNexis maintains electronic records for *The New York Times* through 1980. Many studies use *The New York Times* as an indicator of trends in national news, and there is evidence that coverage in other prominent sources tracks well with coverage in the *Times* (Althaus et.al 2001; Soroka 2002; Woolley 2000). A list of the 12 topics, related keywords, and the number of stories associated with each topic is available in the appendix. [13] LexisNexis includes articles to the present day, but the searches here are limited to 2010 because that is the last year public mood data is available for the 12 topics in question. Tracking the number of stories about each topic

[13] Questions can always be raised over the competing merits of different keywords and a central concern is that they will fail to adequately cover the range and depth of a policy topic. To test the robustness of the findings the appendix to this chapter repeats the analysis using a measure of media coverage that does not rely on keyword searches. Amber Boydstun, in *Making the News: Politics, the Media, and Agenda Setting* (2013), coded the front page of every *New York Times* from 1996 through 2006, recording the policy topic of each story. After matching policy topics across coverage and public mood, the appendix replicates the analysis and finds no substantive difference from the results based on LexisNexus searches.

over time makes it clear that coverage is not evenly distributed. Of the 12 topics, some routinely generated hundreds of stories a year, while others rarely exceed 20 stories annually.

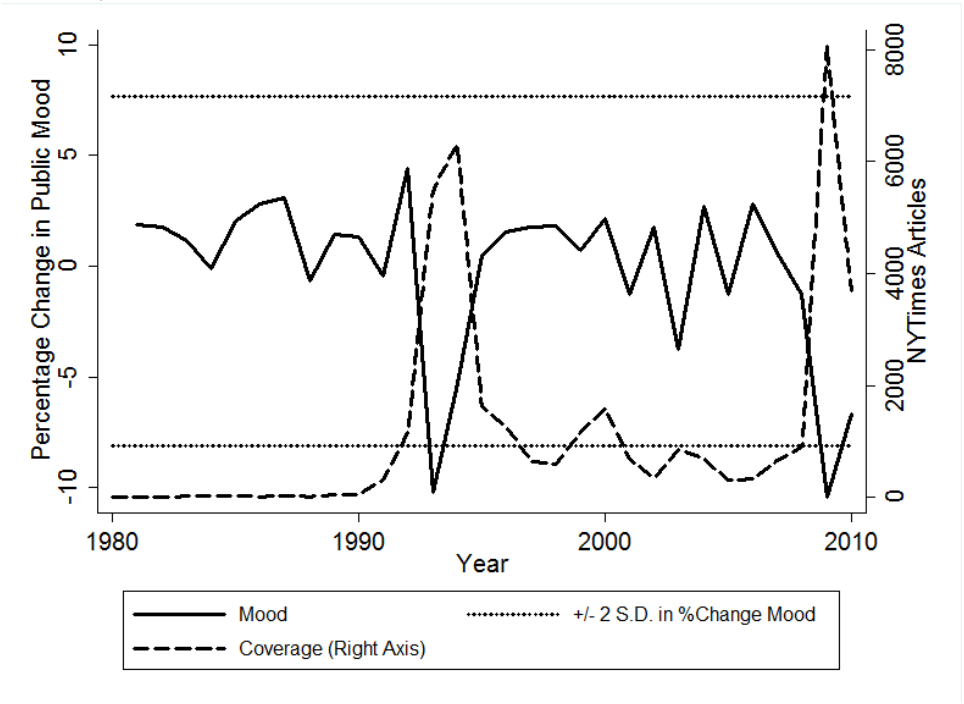
Figure 5.3 provides an example of the expected dynamic between attention and opinion. The figure compares changes in public mood about health care reform (on the left axis) to *Times* coverage of the same topic (on the right). Here we see that annual coverage of comprehensive health care reform in the *Times* is usually sparse, drifting between 0 and 200 articles a year, but during the early 1990s and late 2000s, coverage of this topic increases dramatically. At the same time, public mood about health care reform drops precipitously, indicating that the public feels the government should be 'doing less' about this issue. The dotted horizontal lines, which indicate two standard deviations in mean for percent change in public mood, reveal that the changes in mood that occur during the two periods of heightened coverage are by far the largest shifts in mood occurring at any point in the time series.

During these years the government was debating whether or not to enact health reforms, so the *Times* was covering this issue for a good reason. We can say that health reform, which for the most part is paid little attention, rose to sudden prominence for a few short years, followed by an equally rapid decline. [14] In this way, the figure illustrates the dichotomy between incremental drift in opinion when attention is scarce versus dramatic changes when attention is concentrated. The example is also illustrative in that the ultimate outcomes of the Clinton and Obama health reform initiatives were very different, but in both cases the magnitude of opinion change was

[14] For health care reform, attention is correlated with negative movement in opinion, indicating a public that prefers a diminished role for government on this issue. The relationship between attention and opinion change works in the other direction as well. For example, coverage of failing schools, dilapidated infrastructure, or poor health outcomes may provoke the opposite reaction from the public.

similar. This demonstrates that levels of attention can affect movement in opinion absent any actual policy adjustment by government.

Figure 5.3. Comparing trends in Media Coverage and Public Policy Mood for Health Care Reform, 1980 to 2010




To expand the analysis beyond health care reform, I define topics as 'highly covered' in any year where a story about that topic appeared in the *Times* at least two out of three days, on average. Having set this basic definition, the analysis is straightforward. I test if the size of opinion changes is larger for issues that are highly covered. Table 5.1 provides the answer by showing the results of a difference of means test between the magnitudes of opinion change across the two coverage conditions.[15] The results indicate that moving from periods of low to high coverage corresponds with an almost two-fold increase in the average magnitude of opinion changes. The related t-statistic is significant with a p-value of less than 0.05.

[15] Other definitions for a highly covered topic are considered in the appendix, but the results are substantively unchanged.

Table 5.1. Mean Magnitude of Opinion Change by Media Saliency

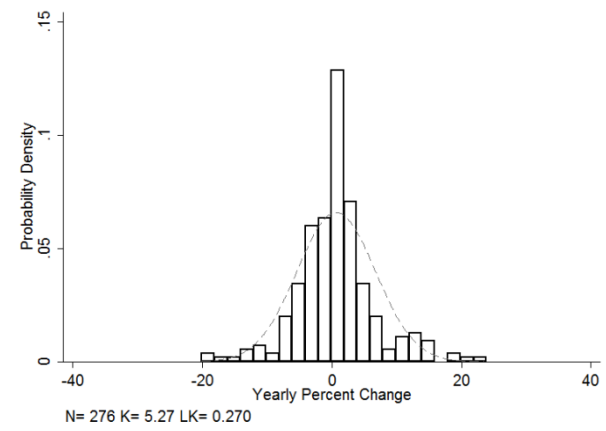
| Media Saliency | Observations | Standard Deviation | Mean Change |
|---|---|---|---|
| Low | 276 | 4.47 | 4.13 |
| High | 82 | 8.69 | 7.98 |

Note: t-value = -5.34 (significant at 0.05 p-value)

Figure 5.4 displays the probability density distributions of aggregate changes in public mood for periods of low and high media coverage. Holding the range of the axes constant across distributions highlights notable differences. Shifts in mood on topics receiving low levels of coverage are predominantly incrementally. On the other hand, the distribution associated with highly covered topics has much wider tails, indicating that opinions on these topics are prone to large swings. Figure 5.4 provides visual evidence consistent with the results in Table 5.1. The magnitude of opinion change can be linked to attention, with large changes taking place where attention is concentrated and marginal changes where attention is diffuse.

Figure 5.4. Probability Density Distributions of Aggregate Changes in Public Policy Mood, by Media Coverage

a) Low Coverage




b) High Coverage

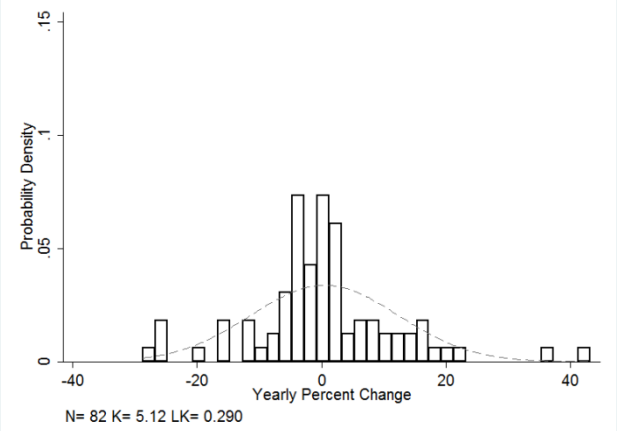



Table 5.1 and Figure 5.4 establish a correlation between amounts of coverage and the size of opinion changes. The chapter estimates an error correction model to determine if there is a causal relationship as well. While previous scholarship demonstrates that the tone and intensity of coverage can predict changes in opinion, the inquiry is typically if media content influences

the direction of opinion changes. The dependent variable in the model is the magnitude, or absolute value, of opinion change, as the goal is to determine if amounts of coverage affect the size of shifts in opinion, regardless of the direction those shifts may take. The independent variable is the number of *New York Times* articles on a topic in a given year.[16]

The model uses median regression and is designed to assess both short-term and error-correction causality, with the coefficient for the differenced variable speaking to short-term effects and the coefficients for the lagged variables the long-term, or error-correction, effects.[17] The negative and statistically significant coefficient for lagged opinion change indicates that the public mood series is autoregressive, meaning that a surge in opinion in one year quickly deteriorates over proceeding years. The coefficient for differenced articles is positive and statistically significant, while the coefficient for lagged articles is positive, but not significant. This indicates that the quantity of coverage has a short-term effect on the size of opinion changes only, which is as expected. The public can react quickly, but has a short-term memory, so last year's news stories do not affect movement in public opinion today.

[16] An additional independent variable that may have relevance to the size of opinion change is government spending. The model does not include a measure of spending because the topics used in the analysis do not correspond very well to Office of Management and Budget spending programs. It is therefore difficult to match government spending with the relevant opinion series. Furthermore, the extent to which the public is even aware of government spending reallocations is often contingent on media coverage. As the example in Figure 5.4 illustrates, media coverage can be more important to public opinion (at least in the short-term) than actual spending levels. The Clinton health care initiative failed and resulted in no new spending, while the Obama initiative resulted in sizeable reallocations. In both cases, the magnitude and direction of opinion change was the same.

[17] Regression by ordinary least squares is particularly sensitive to outliers, so variables with many extreme values should be used with caution in conjunction with this technique (Fox 1991; Knoke and Bohrnstedt 1982; Harden and Desmarais 2011). Median regression, which is robust against outliers, may provide a useful and more efficient estimator in these cases. Median regression is similar to OLS, but instead of regressing toward the mean the model regresses toward the variables' median values.

Table 5.2. Predicting Magnitude of Opinion Change

| Variable | Coefficient | Standard Error |
|---|---|---|
| Opinion Change$_{(t-1)}$ | -0.48* | 0.03 |
| Δ Articles | 3.70* | 0.96 |
| Articles(1,000) $_{(t-1)}$ | 1.18 | 0.61 |
| Constant | 0.93* | 0.30 |

N = 346
Pseudo R-squared = 0.133
* = significant at 0.05 p-value

A one-unit increase in the article variable corresponds with 1,000 additional *Times* articles. The causal effect of coverage on opinion change is therefore modest, with each additional 1,000 articles corresponding with an approximately 3% increase in the magnitude of opinion change. The sample, however, is limited to 12 topics. The largest absolute value of opinion change across those topics is 40% and the mean magnitude of change is 5%. Meanwhile, in some years over 5,000 articles were published about a topic and the average level of coverage for a topic was 610 articles per annum. In the case of comprehensive health care, coverage went from fewer than 100 articles in a year to over 8,000 and under these circumstances the model would predict at 24% shift in opinion. In this context, the size of the coefficient for articles is not trivial.

## Discussion

The model of public information processing the chapter develops advances the study of mass publics by emphasizing that although sophisticated, they are also boundedly rational. An understanding of how basic limits to human cognition affect mass publics can explain why changes in public opinion are prone to both incrementalism and sudden surges. While these tendencies have been noted previously, the chapter's contribution is to integrate both types of change into a larger theoretical framework, illustrating that opinion changes are inherently

dichotomous; marginal and idiosyncratic where attention is absent and, potentially, dramatic when attention is concentrated.

## CHAPTER SIX: THE PRIVATE SECTOR, MARKETS, AND THE SDEARCH FOR STABILITY

The General Punctuation Hypothesis makes a broad claim - that changes to the outputs of any complex human decision-making process will be characterized by both incrementalism and sudden disequilibria. This claim has been tested extensively when it comes to government outputs. A rigorous test of the hypothesis must look well beyond governments, however. Organizational decision-making is obviously widespread outside the public-sector, so it is possible that the well-documented kurtosis in government outputs is actually unique to governments and not indicative of human-decision making at large.

Under what circumstances would proportional decision-making be more likely? Governments, and especially national governments, are faced with an exceedingly complex task, but if we direct the search for proportionality away from governments toward organizations faced with a much smaller problem space, then bounded rationality might not be such a limiting factor. Further, previous scholarship has documented that market outcomes show very low kurtosis and, as I discussed in Chapter 1, there are good empirical reasons to expect that in many cases collective outcomes based on the decision-making of multiple independent actors will be more stable than outcomes from centralized decision-making processes.

The chapter proceeds along these lines, searching for cases of stable change distributions where outcomes are based on markets and among organizations faced with relatively straightforward goals. Finding such a distribution would present a challenge to the General Punctuation Hypothesis, demonstrating that in some circumstances human decision-making is

not characterized by punctuations. The size of the challenge, however, would depend heavily on the length and breadth of the search. If it turns out that normally distributed outputs abound, but that a collective focus in the literature on governments has obscured what is in fact a common occurrence in the private sector, then we would have to seriously rethink the merits of the General Punctuation Hypothesis (and probably rename it the Conditional Punctuation Hypothesis). On the other hand, if the search turns up empty, or if normally distributed outputs can only be associated with organizations of such limited scope that few are likely to exist, then we can be confident that the General Punctuation Hypothesis adequately describes the bulk of human decision-making.

## Collective Outputs

The apparent rarity of normally distributed outputs in politics is something of an irony, given the abundance of such distributions in the natural world. As discussed in Chapter 2, many inputs to government policymaking may be based on natural processes, which are often normally distributed. Figure 6.1, for example, shows the distribution of aggregate changes to the average monthly temperature in Los Angeles from 1881 through 2006 in the right-panel, while the left-panel tracks actual temperature levels over the same time period[18]. With an l-kurtosis value of 0.113 this distribution comes very close to the normal, which has an l-kurtosis of 0.123. This fact is not immediately apparent from simply observing the left-panel where, without smoothing, the time series looks erratic. Processes may appear to be moving stochastically or without any apparent order, but still form normal distributions when outputs are assessed collectively.

[18] This data is collected by regional weather stations and made available by the National Oceanic and Atmospheric Administration (NOAA). Temperatures are listed in degrees Celsius.

Figure 6.1. Average Monthly Temperature in Los Angeles, CA from 1881 through 2006
a) Degrees Celsius b) Aggregate Temperature Changes

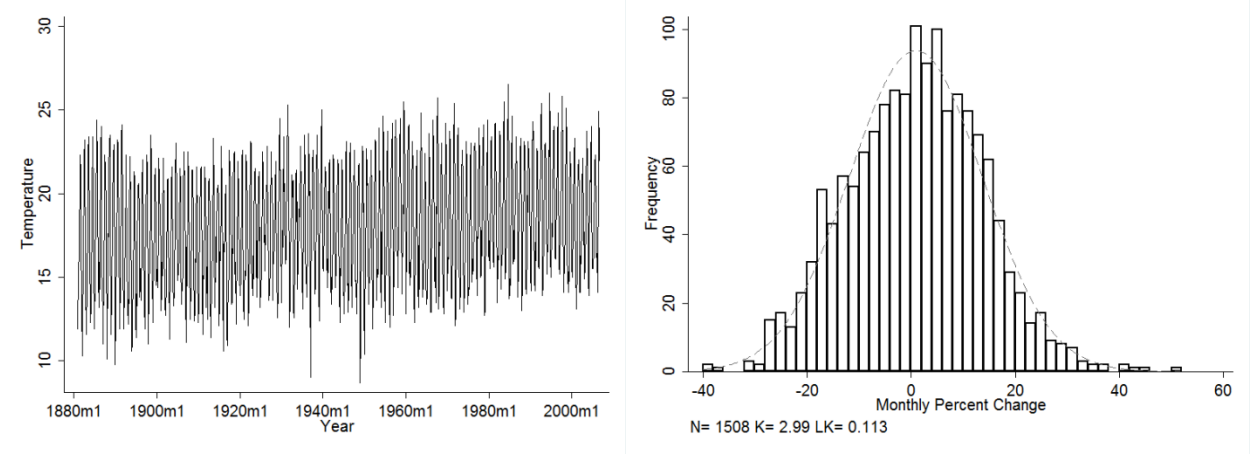
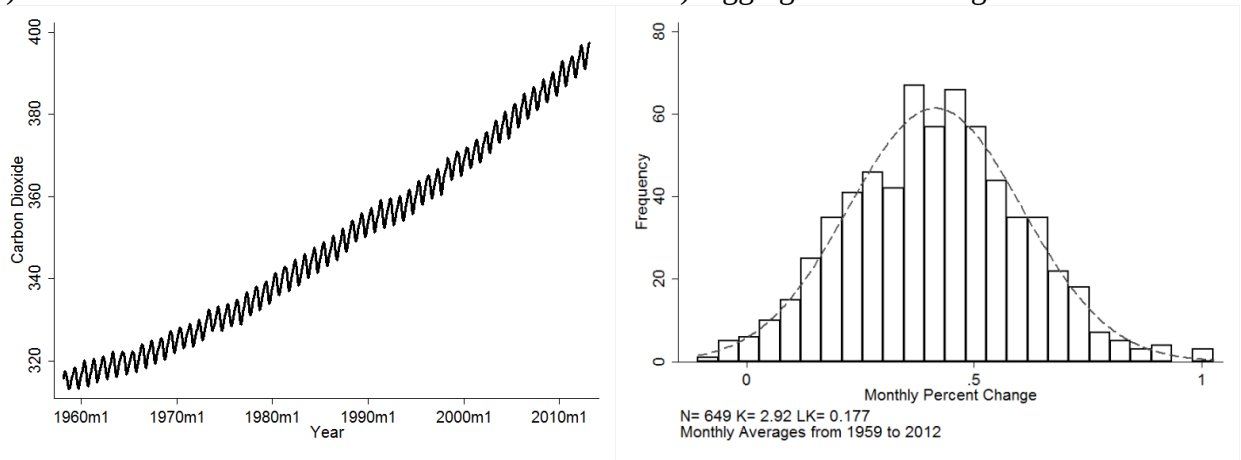



Figure 6.2 gives another example of a process that approximates the normal distribution. The right-panel is an aggregation of monthly changes to atmospheric carbon dioxide levels and the left-panel tracks the same data from 1959 through 2012[19]. Looking at the left-panel we again see considerable variance over time - like temperature, carbon dioxide levels fluctuate seasonally - and in this case there is also evidence of an upward trend. Even so, aggregate changes in carbon dioxide come very close to the normal distribution.

[19] Carbon dioxide in the atmosphere is measured in parts-per-million. The data is collected by the Mauna Loa Observatory and made available by NOAA.

Figure 6.2. Average Monthly Atmospheric $CO_2$ Levels from 1959 through 2012

a) $CO_2$ Levels b) Aggregate $CO_2$ Changes

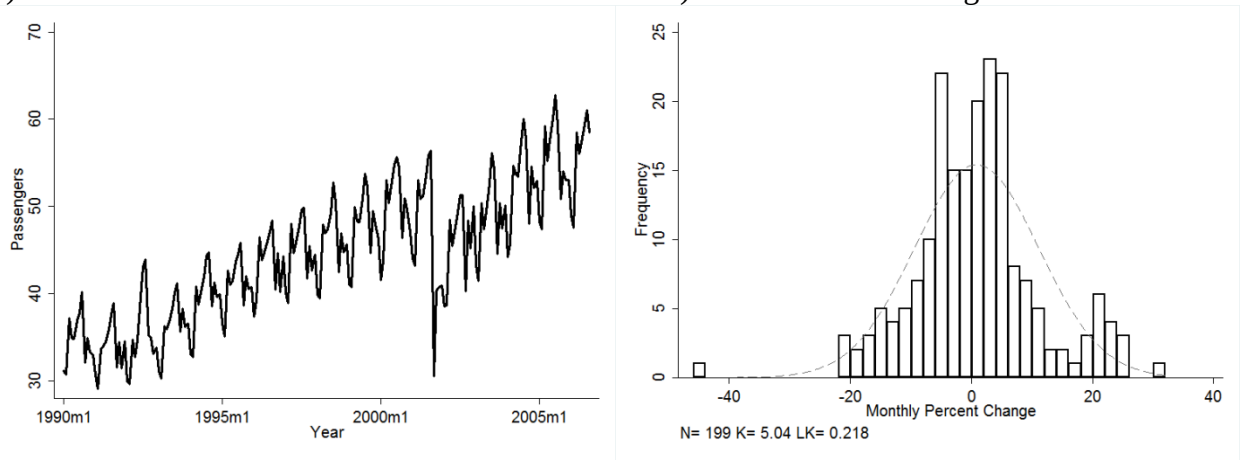



This brief review illustrates a large point – that many inputs relevant to policymaking will be normally distributed. What about outputs of policymaking, or human decision making more generally? The central prediction of the General Punctuated Hypothesis is that inevitable inefficiencies in human decision-making transform normal inputs into fat-tailed outputs.

In fact, normally distributed outputs are fairly common to human decision-making processes, so long as the process takes place over multiple independent decision-makers. A classic example, discussed in Chapters 1 and 4, are stock market returns, which in the aggregate approximate a normal distribution. Chapter 4 also showed that changes to economic fundamentals, which are based on the behavior of many independent actors, are much closer to the normal distribution than government outputs. But the result is not unique to economics and can often be found where outcomes are determined by the independent decisions of multiple actors. Figure 6.3 looks at air travel, showing aggregate changes in the number of monthly passengers in the right-panel and the total number of travelers over time on the left.

Figure 6.3. Average Monthly Number of Air Travelers from 1990 through 2006

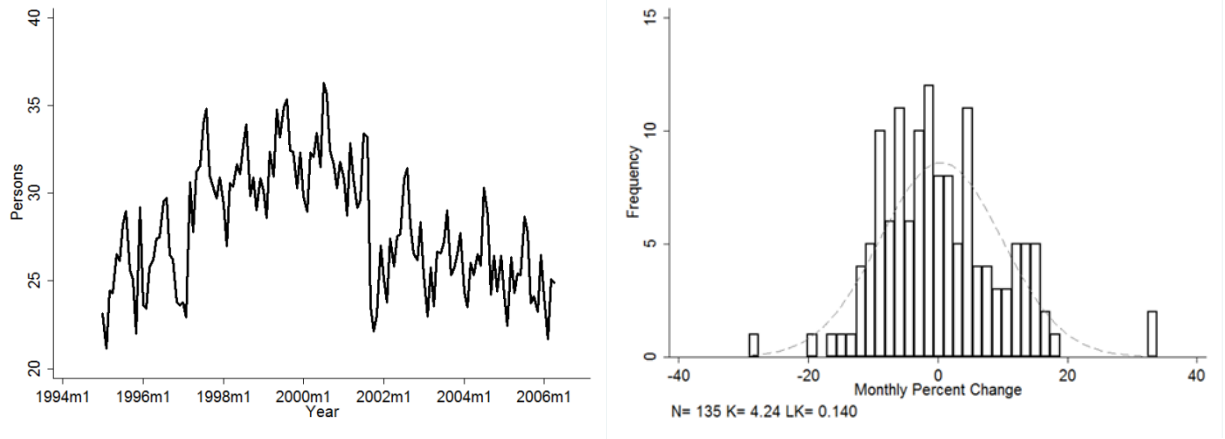
a) Number of Travelers b) Distribution of Changes in Travelers




Rates of air travel are obviously based on human decision-making and while the distribution in Figure 6.3 is not exactly normal, it is much closer to the normal distribution than any previously explored government output. Figure 6.4 gives another example – the distribution of changes in monthly border crossings into the United States. This distribution, with an l-kurtosis of 0.140, also comes close to the normal.

Figure 6.4. Average Monthly Border Crossings into the United States from 1995 through 2006

a) Number of Crossings b) Distribution of Changes in Crossings




It would seem that outputs of human decision-making often conform to the normal distribution, or at least come very close. Early in the search for stable outcomes, a qualification to the General Punctuation Hypothesis presents itself: it applies predominantly to the decisions of a person or organization operating in isolation. That is, once we start aggregating across

autonomous decision makers, the Central Limit Theorem reasserts itself and the resulting output distribution will be approximately normal. This principal is well understood and likely comes as no surprise to Jones and Baumgartner, who published the original stock market result. Still, it remains an important caveat to the Hypothesis, as markets and other collective outputs play a major role in politics and society. Instability and punctuations do not inevitably result from human enterprise.

### Exchange Rates, the RGGI, and Airline Deregulation

An example of the difference between collective and centralized decision-making manifests itself in the politics of exchange rates. The Foreign Exchange Market (FOREX) is the largest in the world, trading an average of $5.3 trillion each day (Bank for International Settlements 2013). Currency trading is clearly a major enterprise and represents an important component of most country's monetary policy. There are, however, many strategies a country can employ to manipulate the price of its currency on the international markets. China, the highest-profile manipulator, artificially lowers the price of its currency by buying large quantities of U.S. dollars and aggressively selling its own currency. This cheapens the price of Chinese exports, effectively undercutting their international competitors. Objections to this type of manipulation are widespread. The U.S. maintains that it perpetuates a global trade imbalance by making it difficult for U.S. manufactures to gain a foothold in domestic and international markets. A more sweeping concern is that China's policies are causing its economy to overheat and that a massive downturn is pending, unless efforts are made to stabilize its growth rate.

China is a blatant case, but currency manipulation can take many more subtle forms. The degree to which a country manipulates its currency is best thought of as a scale, ranging from the most flexible or freely traded currencies, to the least flexible, tightly controlled currencies. For

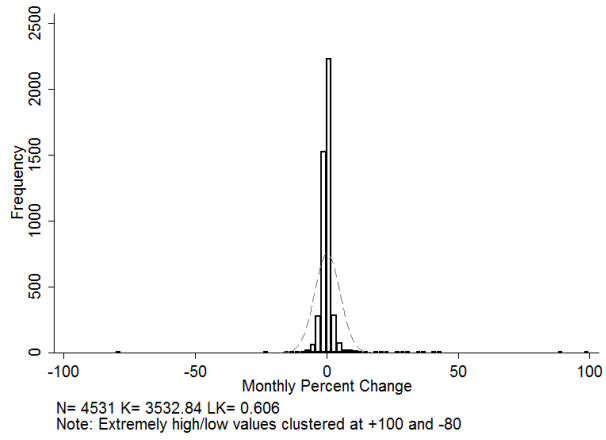
simplicity, the World Bank offers three general categories – free floater, floater, and manipulated. Countries with free floating currencies allow their currency to fluctuate according to the whims of the international market, while countries with manipulated currencies pursue strategies to artificially hold their currency at some specific pre-determined level.

This framework provides a natural experiment to test the differences between collective decision-making and isolated governmental decisions. We can expect that aggregate changes in the value of free-floating currencies will be normally distributed. On the other hand, the value of manipulated currencies is essentially a matter of public policy, and like most other public policies we would expect to see frequent punctuations. Currencies that the World Bank classifies as floaters should fall between these extremes.

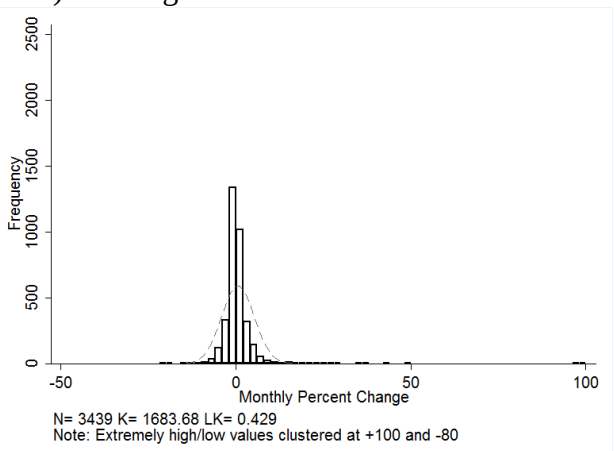
Using historical exchange rate data for 40 countries, available online through the World Bank website, I test these expectations. For each country, the exchange rate relative to the U.S. dollar is tracked on an average monthly basis, from 1994 through 2013. Of the 40 currencies, 18 are classified by the World Bank as manipulated, 15 as floating, and 7 as free floating. Figure 6.5 shows the change distributions associated with each category, with the range of the y-axis held constant to facilitate comparison.

Figure 6.5. Aggregate Changes in Exchange Rates across Three Categories of Currency Manipulation

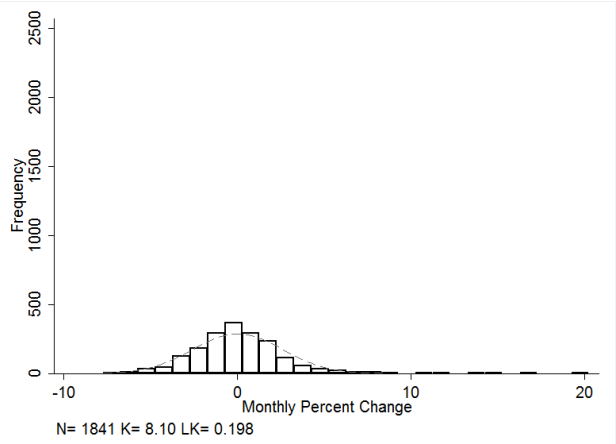
a) Manipulated




b) Floating




c) Free Floating




Manipulated currencies show a distribution with an l-kurtosis of 0.606, floating currencies have an l-kurtosis of 0.429, and free floating 0.198. These statistics indicate substantively important differences in the likelihood of a currency undergoing punctuations in value. This variance is not random, but meets prior expectations. When exchange rates are determined by markets, the resulting distribution is almost normal, but when government policies set the rate of exchange, punctuations occur frequently.

Is this direct evidence of inefficiencies in governmental decision-making leading to instability? Maybe, but a plausible counter-hypothesis is that countries that manipulate their currency tend to be less stable overall than countries with free-floating currencies. In other

words, perhaps systematic political instabilities among the manipulating countries would lead to punctuations in exchange rates even in a market context. After all, a country undergoing a violent regime change sends strong signals to the international community to divest from their currency.

Fortunately, there is an easy way to separate these causal explanations. The World Bank utilizes a 'political stability index' that ranges from -2.5 to 2.5, with negative numbers corresponding to greater instability. Table 6.1 shows the results of an OLS regression predicting the l-kurtosis of exchange rate distributions, calculated separately for each of the 40 countries[20]. Two independent variables are included. One is the average political stability index score for each country from 1994 through 2012. The other is a categorical variable corresponding to the market flexibility categories, with a 1 indicating that the currency is manipulated and a 3 that it is free floating.

Table 6.1 Predicting the L-kurtosis of Exchange Rate Distributions

| Variable | Coefficient | Standard Error |
|---|---|---|
| Market Flexibility | -0.08* | 0.03 |
| Mean Political Stability | -0.06* | 0.02 |
| Constant | 0.49* | 0.07 |

N = 40
Adjusted R-Squared = 0.226
* = significant at 0.05 p-value

Both independent variables are negative and statistically significant, indicating that punctuations in currency rates decrease relative to political instability and free markets. This is not surprising, but serves to illustrate the powerful distinction between outputs from collective versus centralized decision-making processes.

[20] The appendix includes a table displaying the l-kurtosis of each country's exchange rate.

Another example can be found in the Regional Greenhouse Gas Initiative (RGGI) program, which creates a marketplace for power companies to buy and sell carbon credits, within 9 Northeastern states. The goal behind the RGGI is to reduce carbon dioxide emissions as part of an effort to combat global warming. Under the initiative, carbon emissions must be paid for by the purchase of emission permits that are auctioned on a quarterly basis by the participating states. Over time, the idea is to decrease the total number of permits available for auction, thus reducing carbon emissions, with the overall goal of reducing emissions to 10% below their 1990 levels. An additional benefit is increased revenues for the participating states.

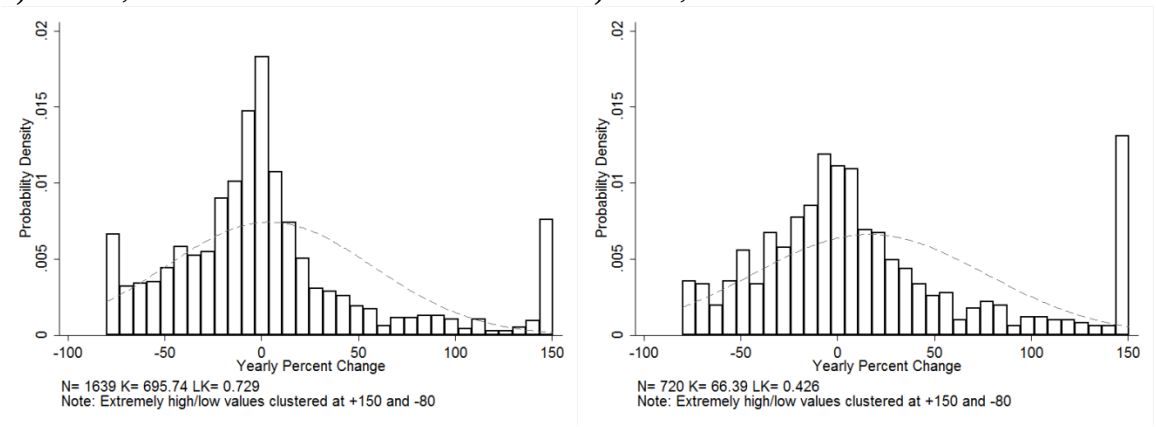
Tracking carbon emissions over time is obviously important for the RGGI as a means to assess progress toward carbon reductions. The initiative provides data on the quarterly emissions of each power plant from the 9 participating states from 2000 through 2008, before the auctions begin, and then from 2009 to 2013 once the market system was in place. Altogether 230 power plants are represented in the data. The RGGI is concerned that the rate of emission has decreased between these periods; my interest is with the stability of changes in the amounts of carbon being emitted. Before the marketplace the amount of carbon released was largely within the purview of each individual power plant. Obviously economic considerations would affect the amount of carbon each power plant could generate on an annual basis, but the decision-making that governed carbon emissions was highly centralized. Once the RGGI was in place, the amount of carbon emissions became a function of market processes. This is not to say that centralized corporate decision-making has no role to play in the RGGI, as clearly corporations must decide for themselves how many permits to buy, but the market outcome is based on the interaction of these individual processes.

Figure 6.6 shows the distribution of annual changes in carbon dioxide emissions by each

power plant from 2000 to 2008 in the left-panel and the right-panel shows the distribution of changes from 2009 to 2013, after the RGGI was in place. The ranges of the axes are held constant to facilitate comparisons. While both distributions are leptokurtic, the l-kurtosis statistics tell a familiar story. Before the RGGI, when carbon emissions varied according to individual corporate decision-making, the l-kurtosis was 0.729. After the RGGI, when carbon emissions were a function of market processes, the l-kurtosis falls to 0.426.

Figure 6.6. Comparing Changes in $CO^2$ Emissions Before and After the RGGI

a) Before, 2000 – 2008 b) After, 2009 – 2013




The RGGI case is telling because it shows how market decision-making can reduce instability beyond monetary returns. That is, the stabilizing effect of markets extends beyond the expenditures for carbon permits, affecting changes in the emission of carbon itself. Also noteworthy is that the RGGI is a government program, so carbon emissions can be considered a policy outcome, or at the very least an outcome directly affected by government policy. The example illustrates how governments can tailor policies to promote either centralized or market-based decision-making and that this has real consequences for the stability of outputs.

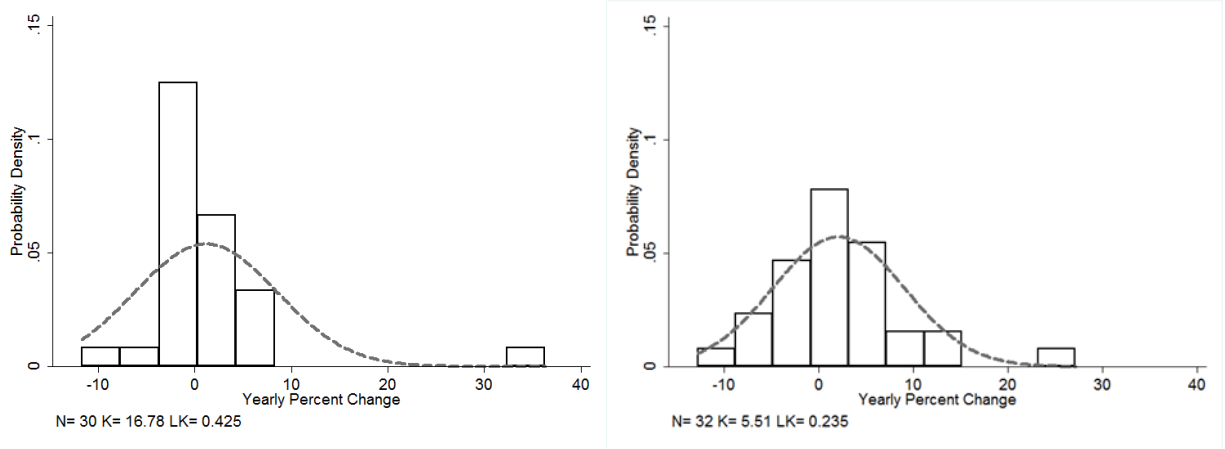
As a final example, I consider airline yields before and after government deregulation of the industry. Prior to 1978 the federal Civil Aeronautics Board (CAB) regulated airline fares, routes, and schedules, treating the airline industry as a public utility. As the industry grew this

approach became less tenable and consumers protested the lack of competition, and subsequently high ticket prices and inconvenient routes. These efforts culminated with the passage of the Airline Deregulation Act in 1978, which quickly phased out the CAB's ability to set fares and eventually eliminated the department altogether. This presents another opportunity for a case study: before deregulation airline fares were essentially a matter of public policy, after they were determined by market forces.

Historic data on actual ticket prices is unavailable, so instead I use a measure of the airline industry's total 'yield', available from 1948 to 2012. Yield refers to the revenue per passenger mile earned by the industry. For example, if the airline industry earned $10 million in revenue in a year and produced 100 billion passenger miles (the total number of miles each airline seat traveled), then the industry's yield is 10 million divided by 100 billion, or 10 cents per mile. Yield is essentially the value of an airline seat to the industry, so it serves as a reasonable substitute for ticket prices. Figure 6.7 compares the distributions of annual changes in airline yield before deregulation, in the left-panel, and after deregulation, on the right.

Figure 6.7. Comparing Changes in Airline Yield Before and After Deregulation of the Industry

a) Regulated, 1948 – 1978 b) Deregulated, 1979 – 2012



Once again, we see that outputs stabilize after moving to a market system. When the airline industry was regulated by the CAB the change distribution shows an l-kurtosis of 0.425. After deregulation the l-kurtosis falls to 0.235. Holding the range of the axes on both figures constant highlights the transformation from one period to the next. The caveat to this analysis is that yield is only publicly available as an industry total, instead of on an airline-by-airline basis. As such, the total number of observations is relatively low, justifying some caution in the interpretation of the distributions[21].

## The Private Sector

The frequency of punctuations in organizational outputs is a function of how efficient an organization is at processing and responding to information. A consistent rhetorical theme in American politics is that the private sector is vastly more efficient than government. Clear goals – to make more money – and a limited bureaucracy are usually cited as factors giving private companies a comparative advantage. This perception, coupled with Americans' deep-seated distrust of 'big government', make calls to privatize government programs a regular campaign slogan.

There are good reasons to be skeptical of claims that private companies will operate more efficiently than government. Pundits may have made up their mind, but the scientific

[21] What is the difference between the collective outcomes observed in this section and the distribution of changes in public opinion I examine in Chapter 5? Mass opinion is assessed by aggregating over many independent actors, so why are changes in opinion highly punctuated? I suspect the answer is that political opinions are unlike other tangible items that are traded on commodity markets. We know that people have weak political opinions to begin with, so new information has the potential to cause major fluctuations. Most important, many collective outcomes are based on decisions by independent actors using very different bases of information and then acting in their own financial self-interest. The same is not true about political opinions, where media coverage will direct national attention toward a few high salient topics. That is, there is a tendency for the public to 'discover' the same issues in unison.

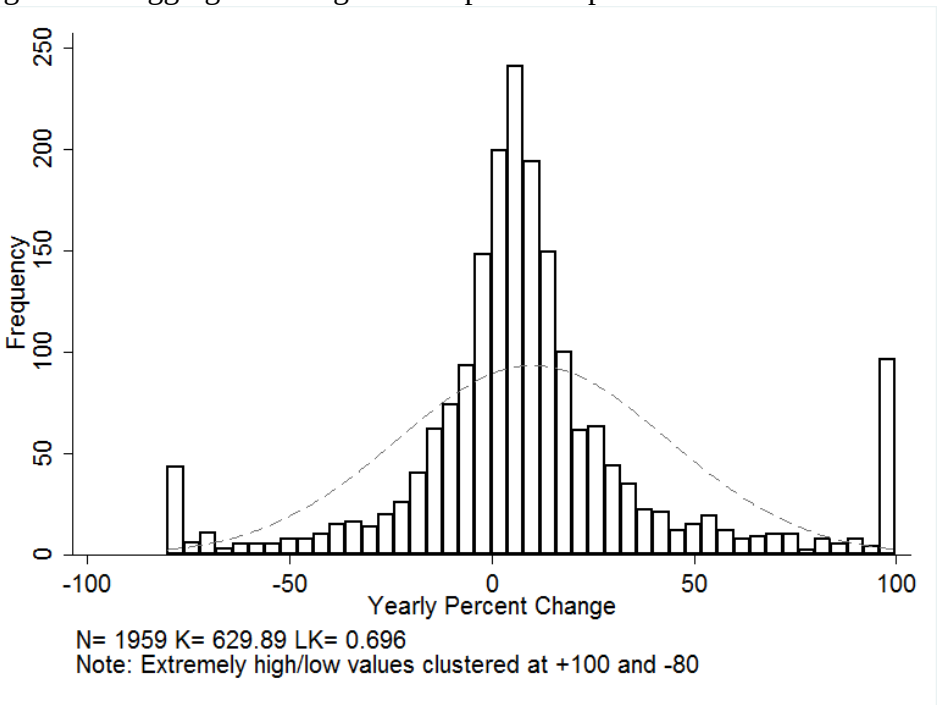
literature is less decided, with numerous articles reporting negligible differences between corporate and government effectiveness, or even giving an edge to government (Mohan and Ray 2004; Rainey and Bozeman 2000; Brewer and Brewer 2011; Camilleri and O'Callaghan 1998; Lan and Rainey 1992). From an agenda setting perspective, corporations are just another type of organization that will also suffer from cognitive and institutions limitations, albeit to varying degrees. Critically, there is a major difference between the information processing capacities of a market, as opposed to an individual business entity operating within a larger free-market system. There is no reason why any single company will be better at processing information simply as a virtue of being 'tapped in' to the market system. Rather, the ability of a company to process and respond to information will depend heavily on internal management structures and the scope of the business enterprise.

Still, the search for stability may benefit from a focus on the private sector. An advantage this perspective offers over previous scholarship, which focuses exclusively on government outputs, is that there is tremendous variance across the private sector, not only because there are many more businesses than governments, but also because the complexity of the underlying tasks varies widely across businesses. Governing, even at the local level, is complicated and given the volume of information that may be relevant to governing it is no wonder that it can only be processed disproportionately. As Chapter 2 made clear, however, some policy domains are more stable than others. Changes to Social Security and Medicare rarely saw punctuations, for instance. These programs are only two of the national government's many concerns, so they exert little influence on the full distribution of changes in government outlays, but what if there was an organization whose only job was to process Social Security payments? We can easily imagine a company that, if not Social Security, has business interests

that are extremely narrow in scope, perhaps based on a normally-distributed underlying process where changes are easily predicted. In this case, where outputs would be closely tied to a normally-distributed process, bounded rationality might not be such a limiting factor.

To explore this possibility data on corporate expenditures is collected using Security and Exchange Commission (SEC) filings[22]. A range of industries is represented, from fast food (McDonalds), to insurance (Progressive), and furniture retail (Haverty's)[23]. Each company breaks their expenditures into different annual categories. The longest time series is from 1991 through 2012, with some companies having data for a shorter period of time. Figure 6.8 shows how changes to these annual expenditures are distributed, across time and companies.

Figure 6.8. Aggregate Changes in Corporate Expenditures




[22] Data is only available to publicly traded companies, which is unfortunate as many companies that are large enough to sell stock have diversified interests, complicating decisions concerning expenditures.

[23] The appendix lists each of the companies used in the analysis and the l-kurtosis of their expenditure distributions.

With an l-kurtosis of 0.693 the distribution closely resembles distributions of government outputs – both feature tall central peaks and fat tails. Clearly the private sector is not any better at producing stable outputs than the government, at least not across the 18 companies under consideration here. What if we break the distribution in the figure apart and consider an individual company?

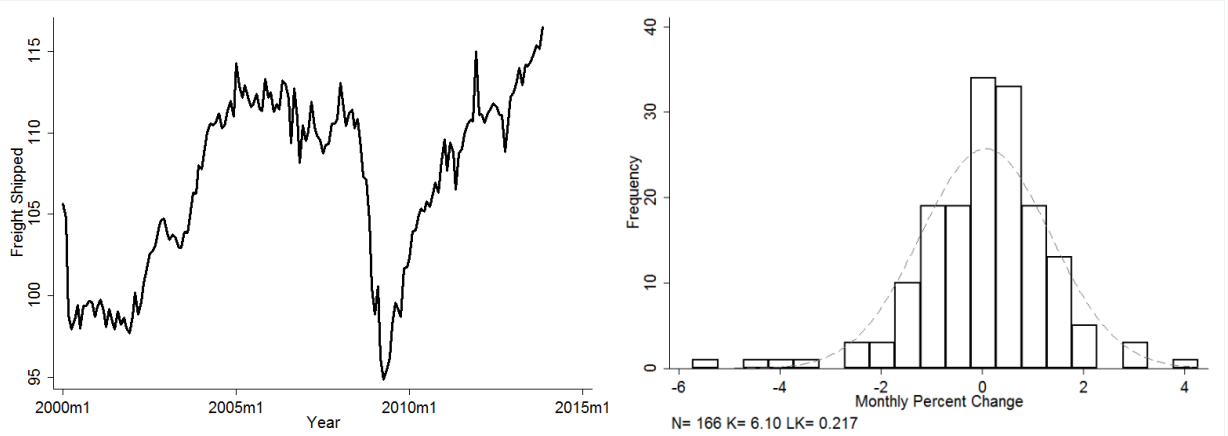
## The Union Pacific Railroad

The Union Pacific Railroad is one of the oldest and largest railroad companies in the country, operating over 30,000 miles of track in the Western United States. It specializes in moving freight – a broad category encompassing almost everything except pets and people – around the country (Union Pacific Corporate 2011). Operating in the railroad business certainly has its fair share of complications. Anything in the way of environmental hazards, new government regulations, or evolving competition from rival companies will pose potentially major challenges to traditional ways of doing business. But with all that, a firm the size of Union Pacific, being the largest rail operator in the United States, can expect that demand for its service – shipping freight – will be closely linked to general economic fundamentals. When the economy is doing well, more freight, in the form of raw manufacturing materials and finished consumer goods, needs to be moved around the country. During economic downturns, there is less consumer demand, corresponding to fewer items that need to be shipped.

Figure 3.4 from Chapter 3 showed that distributions of GSP and GDP tend to have relative low l-kurtosis values and the expectation is that the distribution of changes in the amount of freight being shipped will look very similar. The Department of Transportation provides access to data compiled by the Association of American Railroads, a lobbying group representing major rail operators, on the amount of freight shipped in the United States by rail

from 2000 through 2013 on a monthly basis[24]. Figure 6.9 shows the distribution of monthly changes across this dataset and, with an l-kurtosis value of 0.270, its shape closely resemble distributions of changes in economic fundamentals. Also note, in the left-panel, the dramatic drop-off in the amount of freight being shipped corresponding with the start of the 2008 recession.

Figure 6.9. Monthly Freight Shipped by Rail in the United States from 2000 through 2013
a) Freight Shipped b) Distribution of Changes in Freight Shipments




From this we can infer that the demand seen by Union Pacific for its service is relatively uniform[25]. This is not to say that change never happens. As the left-panel of Figure 5.7 makes clear some visually-striking movement in freight shipments have taken place in recent history. But even the largest of these changes (the drop in early 2008 corresponding to one of the worst recession in U.S. history) only amounts to an adjustment of about 13 percent. The right-panel figure illustrates that most changes over this time period are only modest in size. Having such reliable demand may greatly simplify the internal budgetary process that Union Pacific

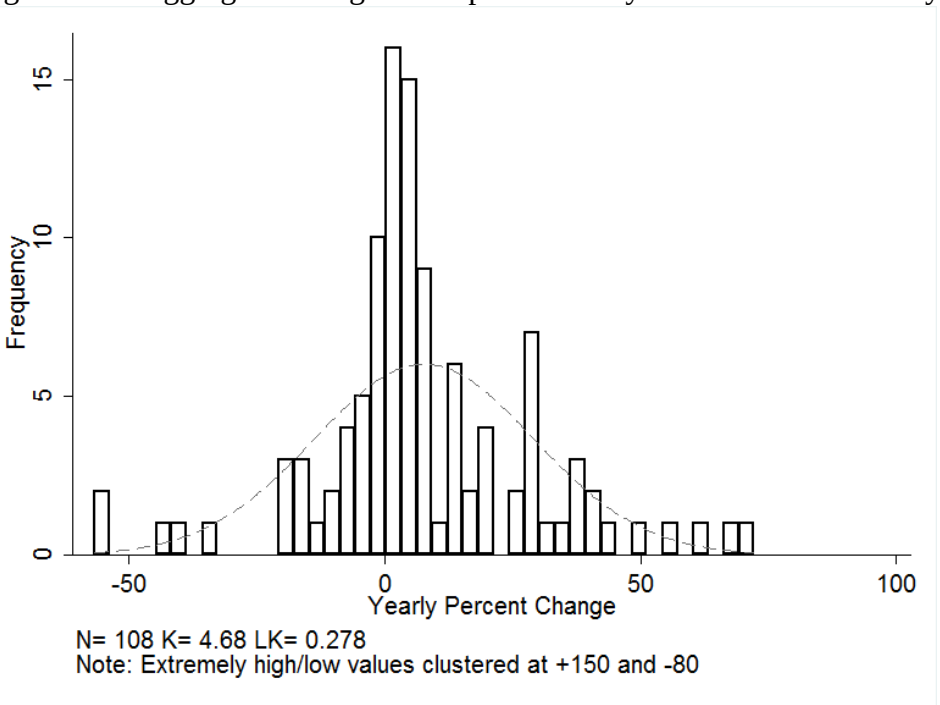
[24] These amounts are expressed in terms of the Transportation Services Index, which is an economic measure of freight movement throughout the United States introduced by the Bureau of Transportation Statistics. The key quantities that form the basis of the index are the number of carloads and 'quarterly ton-miles' of freight shipped by rail each month.

[25] The alternative assumption would that there is pent-up demand for shipping that rail operators are simply unable to meet, so that the distribution of changes in freight shipped only loosely reflects actual levels of demand.

management undergoes each year. Contrast the scope and quality of information relevant to Union Pacific's decision making with an industry where demand is much more fluid and unpredictable. Determining how to allocate money toward products and services may be altogether more difficult for firms in the fashion industry, for instance.

Figure 6.10 shows the distribution of changes to expenditures by Union Pacific from 1994 to 2012, across 4 distinct spending categories. The associated l-kurtosis is 0.278, which is only slightly above the value associated with the distribution of freight shipments. Clearly then, the magnitudes of changes to Union Pacific's expenditures closely mirror changes to underlying economic fundamentals and overall freight shipments.

Figure 6.10. Aggregate Changes in Expenditures by Union Pacific Railway from 1994 to 2012




Does Union Pacific provide an example of proportional information processing? Its expenditures are not normally distributed, but they do closely approximate the shape of the distribution of relevant inputs. At the very least, it would seem that Union Pacific is quite adept at adjusting expenditures in correspondence to the size of underlying demand. This is similar to

what I found in Chapter 2, which showed that outlays on Social Security tracked changes to the over-65 population. The distinction here is that Union Pacific is a full organization, rather than an isolated issue-domain within a larger organizational structure. In all, we have come a long way from the examination in Chapters 2 and 4 of public budgets, which showed governments transforming normal inputs into fat-tailed outputs.

## Discussion

The chapter began by suggesting that the discovery of an organization that could process information proportionally would present a challenge to the General Punctuation Hypothesis, but that the size of the challenge would relate to the breadth of the search. So just how rare are companies like Union Pacific? On the one hand, even simple tasks can become complicated quickly as new areas of conflict or competition are discovered. Furthermore, the distribution in Figure 6.10 only looks at expenditures made by Union Pacific in the recent past. The company has existed since the 1850s, so it is possible that if more data had been available from the SEC the distribution would tell a very different story – one that might include hostile takeovers of other railways or contentious managerial turnovers.

On the other hand, the current search has been limited to publicly traded companies, which are the only ones required to submit SEC filings. Most companies large enough to trade on the stock market have diversified interests, greatly complicating and increasing the range of information relevant to producing an operating budget. A justification for looking at the private sector is to focus on organizations with a very narrow scope or purpose, but attempts to 'drill down' in scale quickly encounter data limitations. It may be that many small, privately owned companies can engage in more proportional information processing.

A major contribution of the chapter is to introduce the distinction between market-based and centralized decision-making as powerfully conditioning the stability of outcomes. It has long been recognized that market outcomes are relatively stable, as compared to governmental outputs. What previous scholarship left unnoted is that many areas of government policymaking are based directly on market outcomes. Beyond governments, society makes wide use of markets, so this represents an important exception to the claim that human decision-making inevitably results in highly punctuated outputs.

## CHAPTER SEVEN: CONCLUSION

The preceding chapters have demonstrated that the instabilities of political outcomes vary systematically according to two factors a) the complexity of issue domains and b) the centrality of decision-making processes. When issues are comparatively simple, or organizations base outcomes on a market structure then changes are smooth and gradual. As issues become more complex and decision-making is centralized, then changes come is a series of fits-and-starts, with predominately marginal adjustments punctuated by dramatic changes.

The implications of these findings are substantial. First, they offer valuable nuance to punctuated equilibrium theory. Previous scholarship uses the theory to explain an observation – that political outcomes show frequent punctuations – and while important, there was little work dedicated to explaining variance within that outcome. Why do some organizational outcomes show more or fewer punctuations than others? Why does instability vary across issue domains? Most seriously, this deficit in the literature left a basic prediction of the theory untested – can we observe instabilities varying with attention such that attention scarcities correlate with punctuations? Ultimately, the test of a theory must lie in its ability to make successful predictions. My research has found that attention does seem to be a crucial factor that can explain political stability – both issue complexity and market-based decision mechanisms relate directly to the capacity of organizations to attend to new information. In summary, punctuated equilibrium theory passes the test; a basic prediction is met.

My research, however, also presents a cautionary tale to anyone expecting political instabilities to be pronounced and inevitable. I documented many cases where, with simple

issues and market-based structures in place, political outcomes change only gradually with time. Further, these conditions are not particularly rare within government, and relatively common taking a broad view of human enterprise. These observations are not hostile to the General Punctuation Hypothesis; rather, because they occur where attention is least scarce, they can be seen as exceptions that prove the rule. Still, given the emphasis in the literature that government decision-making will always results in punctuated outcomes, it is important to note that large areas of policymaking – monetary policy for instance – are not particularly unstable.

My research also invites a second look at the idea that the shape of output distributions has a great deal to tell us about government efficiency. The underlying logic – that inputs relevant to governing should be normally distributed so outputs that deviate from normal indicate sub-optimal policymaking – is sound. But a key finding from Chapter 2 was that many punctuations appear to be in response to stochastic crises. If scientists at NOAA have trouble accurately predicting the occurrence, duration, and path of hurricanes, then we can hardly expect policymakers in Washington to do any better. In other words, the level of precision necessary for governments to be comprehensive information processors far exceeds anything that exists in the world's most powerful supercomputer. From this perspective, I have argued that punctuations can be a seen as a good thing, in the sense that we cannot reasonably expect our governments to foresee ever crisis, but can expect that they will respond dramatically to those crises when they occur. Divorcing the study of political instability from evaluations of efficiency does nothing to diminish this field of study, instead it encourages practical assessments of the ways in which policymaking is or is not successful. Most important, it forces researchers to take a closer look at the inputs relevant to governing in order to determine how governments respond to problems across different issue domains.

Areas for further research are plentiful. Punctuations in government outputs are well-documented, more recent scholarship shows similar patterns of change in media coverage (Boydstun 2013), and my research shows that changes in public opinion are likewise unstable. This raises the tantalizing possibility that punctuations could be traced through the political system. Do punctuations in spending originate as dramatic shifts in public opinion? Do spikes in media coverage precipitate spikes in spending and opinion? Can we establish the existence of a national agenda where the government, media, and public all attend to the same issues at the same time? This line of research has implications for understanding the causes of political instability and also the relationship between three major components of the political system.

Another area for additional research is to further investigate the link between various input series and agenda setting dynamics. We can expect that the process of agenda setting is an interaction between policymakers, public opinion, and the severity of problem indicators. For example, Democratic presidents may wish to focus on unemployment or income inequality – issue domains closely associated with the Democratic Party's platform – but if indicators suggest that these problems are getting better, it would be very difficult for a president to make the case that these are issues worthy of attention. In all, the process by which issues land on the agenda is complex and the literature is far from a fully specified model of agenda setting. My research advances the discussion by showing that the stability of policy outcomes varies substantially according to the relevant inputs, but this only a first step for integrating inputs into agenda setting models. The next step would be to determine how policymakers respond to problem indicators and how this response is conditioned by the severity of underlying problems.

Finally, interview and field-work based research may be highly useful in assessing differences across issue domains in the range of indicators—quantitative and qualitative—that

are actually used in government decision-making. As discussed, it is often difficult for researchers to link indicators with particular budget categories, or policy outcomes. One obvious possibility to surmount this difficulty would be to survey policymakers and simply ask what indicators they pay attention to. This approach would be beneficial for practical reasons – because it would help researchers determine what indicators to associate with what policies – but also theoretically – as it would be interesting to see if instabilities are more likely when there is widespread disagreement over the relevant indicators. A lack of field-work is a significant gap in the literature on the causes of punctuations, or in validating the conceptual model with observations of the process of decision-making in governmental settings.

## APPENDIX 2.A: ALTERNATIVE MODEL SPECIFICATION

Table 2.4 from Chapter 2 presents the results of a logistic regression predicting the occurrence of punctuations in federal spending. As a robustness test, this appendix re-estimates the model, this time as a cross-sectional time-series model with random effects, treating each budget category as the panel unit. This treatment allows me to control for attributes of the various budget categories that are unaccounted for by the independent variables. Furthermore, instead of using a dichotomous classification to distinguish between punctuations and changes of a smaller magnitude, the dependent variable is simply the absolute value of percent change in spending. Table 2.1A shows the results, which are highly consistent with the logistic model from the main text. In particular, the coefficient for subfunction complexity is still a powerful predictor of budgetary change.

Table 2.1A Predicting Budgetary Change

| Variable | Coefficient | Standard Error |
|---|---|---|
| Lagged Absolute Percent Change | 0.05* | 3.47 |
| Dollars | 0.00 | 0.19 |
| Unified Government | 8.10* | 2.15 |
| House Polarization | -27.03 | -0.91 |
| Honeymoon Period | 2.11 | 0.43 |
| Subfunction Complexity | 1.12* | 3.46 |
| Constant | 28.84* | 2.79 |

N = 3,752
$R^2$ Within = 0.00
$R^2$ Between = 0.17
$R^2$ Overall = 0.01
* = significant at 0.05 p-value

## APPENDIX 5.A: LEXISNEXIS KEYWORDS

The table shows the LexisNexis keywords I use to assess media coverage in Chapter 5.

Table 5.1A. Coverage of Policy Topics in *The New York Times* from 1980-2010, with LexisNexis Keywords

| Topic | Total Articles | Search Terms |
|---|---|---|
| Unemployment Rate | 563 | BODY(("unemployment rate" OR "joblessness" OR "jobless rate") w/5 (United States OR U.S. OR America!)) |
| Ethnic Group Discrimination | 1,312 | BODY(("race" OR "ethnicity" OR "ethnic group") w/5 "discrimination") AND (U.S. OR United States OR America!)) |
| Gender and Sexual Orientation Discrimination | 4,355 | BODY(("women" OR "sex" OR "sexual orientation") w/5 "discrimination") AND (U.S. OR United States OR America!)) |
| Freedom of Speech and Religion | 1,427 | BODY("school prayer") |
| Comprehensive Health Care Reform | 3,430 | BODY(reform w/5 ("health care" OR "Medicare") |
| Employee Relations and Labor Unions | 1,801 | BODY(NLRB) |
| Mass Transportation | 6,145 | BODY("mass transit") |
| Poverty and Assistance for Low-Income Families | 1,259 | BODY("Aid to Families with Dependent Children" OR AFDC OR "Temporary Assistance for Needy Families") |
| Urban Economic Development and General Urban Issues | 2,850 | BODY(urban w/5 (revitalization OR renewal OR sprawl OR "economic development")) |
| Banking, Finance, and Domestic Commerce | 11,846 | BODY("Department of Commerce" OR "National Bureau of Standards") |
| NASA , Government Use of Space, Exploration Agreements | 11,196 | BODY(NASA) |
| Research and Development | 1,500 | BODY("National Science Foundation") |

## APPENDIX 5.B: COMPARING DEFINITIONS FOR "HIGH COVERED"

Chapter 5 defines a topic as highly salient if it appears in *The New York Times* at least two out of three days on average. Other definitions for high saliency are compared in Table 5.2A. Less strict definitions correspond with weaker findings, but substantively the results are robust.

Table 5.2A. Comparing Changes in Public Policy Mood during Periods of Low and High Media Coverage across Four Definitions of High Coverage

| Media Saliency | Observations | Standard Deviation | Mean Change | T-value |
|---|---|---|---|---|
| Total | 358 | 5.93 | 5.01 | - |
| Every Third Day | | | | |
| Low | 138 | 4.61 | 4.52 | -2.07 |
| High | 220 | 6.61 | 5.32 | |
| Every Other Day | | | | |
| Low | 197 | 4.35 | 4.16 | -3.02* |
| High | 161 | 7.30 | 6.05 | |
| Two out of Three Days | | | | |
| Low | 276 | 4.47 | 4.13 | -5.34* |
| High | 82 | 8.69 | 7.98 | |
| Every Day | | | | |
| Low | 270 | 4.50 | 4.19 | -4.73* |
| High | 88 | 8.56 | 7.54 | |

* = significant at 0.05 p-value

## APPENDIX 5.C: AN ALTERNATIVE MEASURE OF MEDIA COVERAGE: *THE NEW YORK TIMES* FRONT PAGE

In Chapter 5 I measure media coverage with LexisNexis keyword searches in an effort to assess the amount of attention given to various topics for which public policy mood data is available. While this approach is relatively common in the literature, there can always be discussion about the merits of certain keywords, and of particular concern is the possibility that some search terms are simply much better at targeting a particular issue than others. For example, using 'NASA' as a search term might go a long way toward measuring attention toward space flight and technology, but no similarly encompassing term exist for issues such as banking and finance.

To allay concerns that the chapter results are specific to a particular coding system, this appendix replicates the results using a measure of media coverage that does not rely on keyword searches. In *Making the News: Politics, the Media, and Agenda Setting*, Amber Boydstun (2013) codes the front page of every *New York Times* from 1996 through 2006, recording the policy topic of each story. The advantage to this approach is that the data is comprehensive, so it avoids the potential measurement biases associated with LexisNexis keyword searches. Table 5.3A shows the total number of front page stories on each of the policy topics Boydstun codes for, from 1996 to 2006.

Table 5.3A. *The New York Times* Front Page Articles

| Topic | Number of Front Page NYTimes Articles |
|---|---|
| International Affairs and Foreign Aid | 6,354 |
| Defense | 4,479 |
| Government Operations | 3,958 |
| Law, Crime, and Family Issues | 2,088 |
| Health | 1,799 |
| Sports and Recreation | 1,273 |
| Banking, Finance, and Domestic Commerce | 1,249 |
| Macroeconomics | 964 |
| Civil Rights, Minority Issues, and Civil Liberties | 914 |
| Education | 912 |
| Arts and Entertainment | 769 |
| Labor, Employment, and Immigration | 749 |
| Space, Science, Technology and Communications | 719 |
| State and Local Government Administration | 715 |
| Transportation | 594 |
| Weather and Natural Disasters | 573 |
| Community Development and Housing Issues | 410 |
| Environment | 354 |
| Churches and Religion | 329 |
| Energy | 299 |
| Social Welfare | 273 |
| Public Lands and Water Management | 269 |
| Death Notices | 268 |
| Other, Miscellaneous, and Human Interest | 172 |
| Agriculture | 168 |
| Fires | 129 |
| Total | 30,780 |

Public policy mood data is available for 15 of the topics from Table 5.3A, including most of the policy relevant issues and none of the news-specific topics such as ‘fires’ or ‘sports and recreation notices’. Table 5.4A shows the results of difference of means tests, measuring the magnitude of opinion changes during periods of high and low saliency. Three different definitions of high saliency are considered and the results are robust to where this line is drawn. Using an entirely different measure of media coverage does nothing to alter the findings. Opinion changes are substantially larger in size when topics are highly salient.

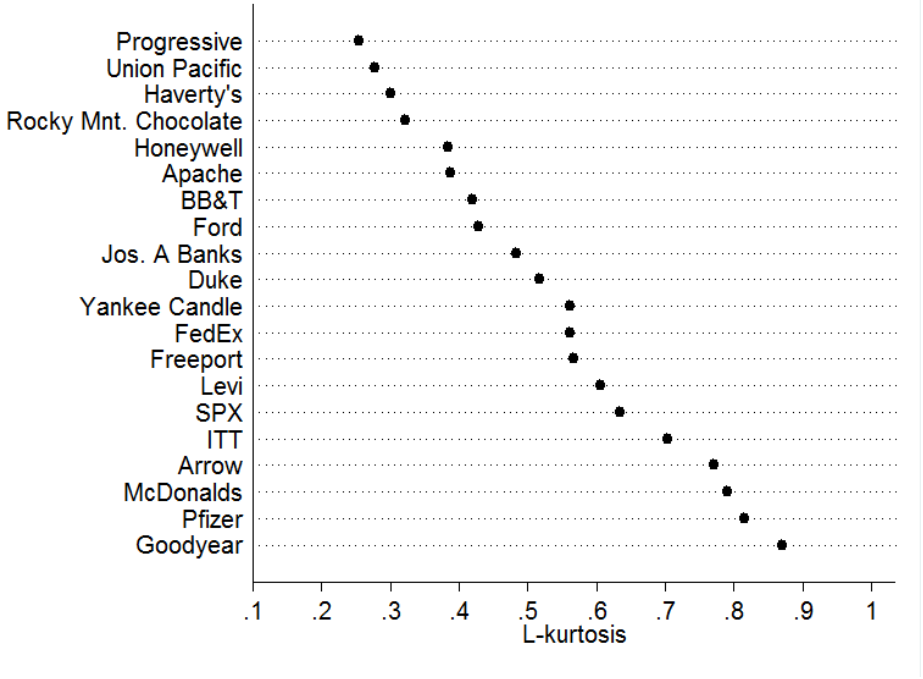
Table 5.4A. Mean Magnitude of Opinion Change by Front Page NYTimes Coverage

| Media Saliency | Observations | Standard Deviation | Mean Change |
|---|---|---|---|
| Low | 137 | 4.55 | 3.84 |
| High (2 out of 3 Days) | 28 | 8.82 | 11.06 |
| Note: t-value = -6.32 (significant at 0.05 p-value) | | | |
| Media Saliency | Observations | Standard Deviation | Mean Change |
| Low | 125 | 4.48 | 3.69 |
| High (1 out of 2 Days) | 40 | 8.25 | 9.38 |
| Note: t-value = -5.56 (significant at 0.05 p-value) | | | |
| Media Saliency | Observations | Standard Deviation | Mean Change |
| Low | 101 | 4.85 | 4.12 |
| High (1 out of 3 Days) | 64 | 7.49 | 6.56 |
| Note: t-value = -2.53 (significant at 0.05 p-value) | | | |

## APPENDIX 6.A: KURTOSIS BY COMPANY

Figure 6.1A shows the l-kurtosis of the expenditure distributions for each company used in the analysis from Chapter 6. Progressive Insurance's expenditures come closest to the normal distribution, followed closely by Union Pacific, and with an l-kurtosis of 0.870, Goodyear is most likely to see major fluctuations in annual expenditure.

Figure 6.1A. L-kurtosis of Expenditure Distributions for18 Publicly Traded Companies



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